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With compliments from the writer

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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS

AND
COMMON FARM PESTS

DURING THE YEAR 1887,

WITH METHODS OF
PREVENTION AND REMEDY.

ELEVENTH REPORT.

BY

ELEANOR A. ORMEROD, F. R. MET. SOC., &C.,

CONSULTING ENTOMOLOGIST OF THE ROYAL AGRICULTURAL SOCIETY; HON. AND CORR. MEM.
OF ROYAL AG. AND HORT. SOC., S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO,
AND CORR. MEMBER OF FIELD NAT. CLUB OF OTTAWA, CANADA; MEMBER
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P R E F A C E .

DURING the past season of 1887 the prolonged heat and drought was accompanied by an unusual amount of presence of various kinds of crop-insects, and also by unusual amount of damage from them.

The attacks of insects injurious to corn-stems were, as is well known, unusually severe. The old-standing attacks of the Barley *Chlorops* and the Corn Sawfly were so prevalent as to be often mistaken for those of new pests, and the new arrival, the Hessian Fly, showed spread over a far wider area than in the previous year; and though it caused little damage to Wheat, was injurious in some cases to a serious extent to Barley. Turnip crops also suffered much, especially from Turnip caterpillar, and from Aphides, commonly known as "blight."

Amongst attacks injurious in fruit farming, which is an increasingly important subject, that of the Pear "Slug-worm," the maggot of a sawfly, was unusually observed, and so was the Black Currant *Phytoptus*, a minute mite, which does much harm to this kind of Currant, and when once established is very hard to get rid of.

Great advance has been made with regard to some of the regular annual causes of loss, either by directly lessening amount of attack or by increase of knowledge, both as to the habits of the insect and methods of treatment reliably available for lessening the evil, which would be exceedingly useful if the knowledge could be more generally spread.

The destruction of Ox Warble has been especially shown (by the widespread observations of last season following on those of the preceding years) to be a matter easily and cheaply carried out, with great benefit to cattle-owners.

The careful experiments as to the cause of true Clover "Sickness" (as distinguished from disease caused by fungus; maggots at the root; decay at the top; non-thriving from state of soil, &c.) have proved this disease to be so constantly connected with presence of a special kind of "Eelworm" as to make it appear that this *Tylenchus devastatrix* is the cause of this so-called "Sickness." Reports of observations regarding this Eelworm are given under the heads of "Clover Sickness," and of "Tulip-root" in Oats, and show, amongst other points, the facility with which plants of kinds liable to infestation may receive it by being sown over infested remains.

The proof of the migration of Hop Aphis, to and fro, in spring and autumn, between Hop and Plum of various kinds, is very important to Hop growers, because this point, although commonly believed to be the case, was not so certainly known before, especially with regard to the autumn migration; and the new observations made by Prof. Riley whilst in England, on this latter point, open up one certain way towards lessening amount of Hop Aphis.

The means of prevention of the great amount of injury caused to orchard foliage in the spring by the "Looper" caterpillars of the "Winter Moth" have been further experimented with, and the simple measure of putting a band of sticky material round the base of the trees, in previously infested orchards (so as to prevent the wingless female moths creeping up to lay their eggs in early winter), has been confirmed as successful.*

Various communications have been placed in my hands regarding the Sparrow nuisance, but I have not entered on the subject here, as I trust very soon to be able to bring forward the special points calling for grave consideration more effectually than I could do in my own Report.

Other details and notes of attack are given under their respective headings, and, together with these, I have expressed my thanks and acknowledgments to the kind contributors to

* Whilst this report was passing through press I received information from Mr. Robert Mercer, of Rodmersham House, near Sittingbourne, regarding the above point:—"I have followed your advice in using Davidson's Composition, and all through the month of November the belt of mixture at the bottom of the trees was almost covered with the moths."

whom I am indebted for much information, and in some instances for a great deal of trouble ungrudgingly taken both in observation and reporting results. But I should especially acknowledge the valuable aid given by Dr. Ch. Lindeman, Professor at the School of Agriculture, Moscow, in identifying specimens of our British parasites of the Hessian Fly, and in presenting me with type specimens of Russian species for British service. Likewise I am much indebted to Prof. Riley, Entomologist of the Department of Agriculture, U.S.A., not only for his valuable help with regard to the Hessian Fly parasites, but also for much serviceable information on Hop Aphis, and other points communicated both by letter and personally during his stay in England.

To Dr. J. G. de Man, of Middleburg, and to Dr. J. Ritzema Bos, Professor of Zoology at the Royal Agricultural College, Wageningen, Netherlands, I am under great obligations for their skilled assistance, most kindly given in successive examinations during several months relatively to infestation of crops by *Tylenchus devastatrix*; and I cannot omit acknowledgment of communication and also of aid whenever sought from my valued friends, Mr. J. Fletcher, Entomologist to the Dominion, and Prof. W. Saunders, Director of the Government Experimental Farm Stations, Canada, and Mr. Frazer S. Crawford, Inspector under the Vine; &c., Protection Act at Adelaide, South Australia, and also the long labours of my sister, Miss G. E. Ormerod, in translation of German and Spanish Entomological papers, whereby she saved me much loss of time in reference.

I must also acknowledge, with many thanks, the aid given to the subject of prevention of injurious insects by the Press, and especially by the Editors of our leading Agricultural Journals.

The illustrations in the present Report are in some instances from my own drawings, in some from other sources acknowledged together with the figure, and for others (as before) I am indebted to the courtesy of Messrs. Blackie and Son, Glasgow. The crop attacks and those to animals are placed in two divisions, not classed together alphabetically. In the coming season I shall be glad to receive any information bearing on serviceable methods of prevention of farm pests, and to reply to any inquiries to the best of my power, and I desire to draw the

attention of my correspondents and contributors to my change of residence, together with my sister, to St. Alban's, having placed me in a much more favourable position, both for personal communication with those who may wish to consult me, and also for field investigation, than was the case in the immediate neighbourhood of London; and I trust now to be able to carry on more personal examination as to the state of farm pests in the field.

ELEANOR A. ORMEROD,

*Consulting Entomologist of the Royal Agricultural
Society of England.*

TORRINGTON HOUSE, ST. ALBAN'S,
March, 1888.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1887.

CLOVER.

Clover-sickness caused by Eelworms. *Tylenchus devastatrix*,
Kuhn.

During the investigations in 1886 as to the cause of the diseased growth known as "Tulip-root" in Oats, there seemed reason for supposing that the same kind of very minute Eelworms which are the cause of this Oat disease were also the cause of the disease known as "Clover-sickness." This kind of Eelworm (scientifically, the *Tylenchus devastatrix*) attacks a very large number of different kinds of plants, including various kinds of bulbs and grasses, and common meadow and field plants, besides various kinds of corn and cultivated crops; and, from the widespread ravages, the special name has been changed in the last few years from the *Tylenchus dipsaci*, or "Teazle *Tylenchus*," to the *T. devastatrix*, alluding to the "devastations" it sometimes gives rise to.

These *Tylenchi* are excessively minute Eelworms (of the same nature, though not the same habits, as Paste Eelworms), but so small that they cannot be distinguished at all without strong magnifiers, about the 24th of an inch long, and they are to be found as male, female, undeveloped young, and eggs, sometimes in vast numbers, in the attacked plants.

As disease in Clover arises from many different causes, as frost, fungi, &c., it is right to specify that the following observations about *Tylenchus* presence are only meant to refer to cases of the disease

known as "Clover-sickness." There are many kinds of Eelworms, some of which live in earth or decayed matter, or are found outside young corn plants beneath the sheathing-leaves; but the *Tylenchus* under consideration attacks and lives by suction on the growing plant, and causes decay and death in some cases, and in some its presence is shown by a bulbous or deformed growth of the base of the corn plant, or the shoots attacked.

As it is totally impossible for any one to offer a trustworthy opinion as to the kind of Eelworm present, excepting those who have devoted especial attention to the study of the Nematoid worms, I examined as well as I could myself, but also I forwarded specimens to the Netherlands to the skilled examination of Dr. J. G. de Man, of Middleburg, and Dr. J. Ritzema Bos, Professor of Zoology at the Royal Agricultural College, Wageningen, well known for their special attention to this class of pests, and publications thereon; and I acknowledge with many thanks not only the courteous help they have given me by examination of many consignments of specimens, but also the permission to publish, in my own Report, their valuable information.

My first observations on "Clover-sickness" were taken about the end of March, when I received specimens of Clover-sick plants from Mr. Manfred Biddell, of Playford, near Ipswich, with the remark that he had very little of the disease this year. On examination of these plants Dr. Ritzema Bos informed me that he found *Tylenchi* in the short yellowish stems, and certainly eggs, larvæ, and full-grown males, but not full-grown females; but from inspection of the males it was clear, and without doubt, that they were *Tylenchus devastatrix*, and that all appearances showed the cause of "Clover-sickness" to be due to the same kind of *Tylenchus* as that which causes "Tulip-root" in Oats. Other Eelworms were present in the diseased Clover, but these Dr. R. Bos found only in the brown withering parts, and considered that "these so-called *Humus-Anguillulæ* were certainly not the cause of the 'Clover-sickness.'"

On April 22nd Mr. Biddell sent me a further supply of Clover plants for inspection, with the note that "there are in this neighbourhood fewer so affected than usual. The plants first affected are now quite withered away, and will not hold together, but some are sent in all stages that could be found."

Of these Dr. R. Bos reported that he could not find a single *Tylenchus* therein, but found the mycelium of a fungus. Of this fungus Dr. Bos gave some details and observations, but, this being outside my own department, I do not enter on the subject here.

On April 12th Miss M. Curtis Hayward, writing from the Manor Farm, Quedgley, near Gloucester, mentioned that "a piece of Clover

on our farm here is failing in small patches. The piece is looking well altogether, but here and there a plant has entirely died away and the root rotted." Miss Curtis Hayward mentioned that the disease or injury did not appear to be always from the wet ground, as though the Clover had failed in a large patch in a wet place, yet also single plants had gone all over where they were on rising spots of higher ground than the plants around them, which remained green and flourishing.

Dr. Ritzema Bos also replied that he could not find any *Tylenchi* in the Clover plants sent from Gloucester. These Clover plants were in some instances so completely rotted across the stems that the shoot or shoots broke off on being moistened. The leaves at the top of the plants were perishing. I found a few *Anguillulidæ* present in the decayed matter.

On examination of specimens of these plants Dr. J. G. de Man replied to me, on April 14th, that he was inclined to consider a species of fungus as the cause of the disease, and in most of the plants he found, on special examination, myriads of small fungus spores. He mentioned that the *Anguillulidæ*, which were present in very small numbers, were the *Aphelenchus modestus*, and could not be the cause of the disease, because their number was too small.

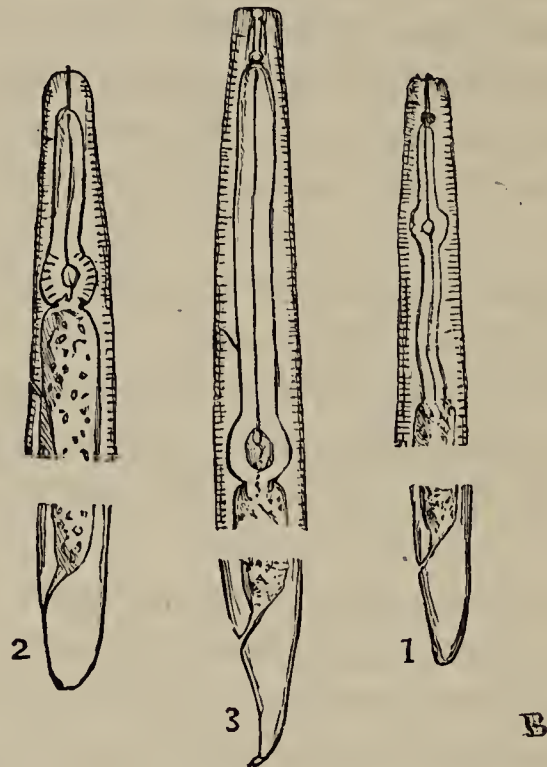
Dr. de Man observed, on April 25th, regarding the plants "supposed to be 'Clover-sick' that you received from Quedgely, near Gloucester, I did not observe any abnormality in them, so that I conclude that they were healthy. I found a few Eelworms in them, all wrinkled and dried up, belonging to *Plectus cirratus*, Bast., *Aphelenchus modestus*, and a species of *Cephalobus*; but they were innocuous in this case. I still may remark that these plants all may be killed by frost, and that frost also may be the cause of the disease of these plants. Perhaps the Gloucester plants have suffered from it."

The figure on the following page, in which the head and tail of three kinds of Eelworm are represented as transparent objects, is added to give some idea of the different internal structure of species of three of the genera mentioned.

In some of the above cases it was not clear that the plants were attacked by true "Clover-sickness," and, as it was of much importance in the investigation to have Clover plants which were not simply diseased, but were suffering under the precise and special form known as "Clover-sickness," I was furnished, on April 20th, with some good characteristic specimens by Mr. C. Whitehead, of Barming House, near Maidstone, with the following note:—

"I send you a box of capital specimens of Clover-sick plants from a 'coomby soil' between the chalk and the greensand in Kent. The roots seem unaffected. The disorder appears to begin just at the

top of the root-stem and crown. The tissues above this and up to the ends of the leaves are disorganised."



ANGUILLULIDÆ.

1, *Tylenchus obtusus* ; 2, *Aphelenchus avenae* ; 3, *Plectus granulatus* (of Bastian); all enormously magnified.

Some of these specimens I sent, by kind permission, to Dr. J. G. de Man, and also to Dr. Ritzema Bos; and, on April 25th, Dr. de Man replied that he had examined the plants with the following results, to which I particularly desire to draw attention:—

“The Clover plants that you received from Mr. Whitehead, of Barming House, near Maidstone, Kent, were indeed diseased, and *Tylenchus devastatrix* ought to be regarded in this case as the cause of the disease. I found the interior of one stem decayed and containing a number of *living* specimens of *T. devastatrix*, both male and female, young individuals, and innumerable eggs. I have studied some specimens, and I have taken exact dimensions of them. So I found that both the male and female attain to a size of 1.5 mm.; the tail measures in both 1-15th to 1-16th of the whole length; the ‘œsophagus’ measures 1-7th to 1-6th of the whole length; and the ‘spear’ in the head has a length of 0.013 mm. All these dimensions perfectly agree with the original description of Kuhn, so that these specimens positively are representatives of *devastatrix*.

“In two stems I found again the fungus spores, on which I have already written to you. The occurrence of the fungus in this case may be either independent of the *Tylenchus*, or perhaps the fungus attacks the plants after having been infested by Eelworms. I cannot decide this question.

“ Sometimes I observed a few specimens of an *Aphelenchus modestus*, but these are not the cause of the disease in this case.

“ I will add that the fungus spores are oval, and are 0·005 to 0·006 mm. long. The eggs of *T. devastatrix* are also oval, and are 0·07 to 0·08 mm. long.”

On April 25th Dr. Bos wrote me that in the plants I sent him on the 20th inst. out of Kent (of which I wrote that they were certainly true specimens of the state of disease known as “ Clover-sickness”), he found several *Tylenchi*, male, female, and eggs. “ The short branches were irregularly thickened, and, in short, these Clover plants showed the greatest resemblance possible in their condition to that of other attacked plants which I know to have been caused by *Tylenchus devastatrix*.” Dr. R. Bos mentioned that he found in the “ sick” plants, and especially in the decaying parts, a few Eelworms of other kinds, but these were in such small numbers that there could be no doubt as to which were the origin of the “ Clover-sickness.”

On April 29th Mr. Whitehead wrote me, from Barming, that he had forwarded fresh specimens of “ Clover-sick” plants, in which he considered he himself could discern the *Tylenchi*, to Dr. Ritzema Bos, who, after examination, sent him the following reply, which I am permitted to insert:—

“ I have yesterday received your packet with Clover-sick plants, and I have found in them, especially in the tops of the branches and the buds, a great quantity of the males, females, larvæ, and eggs of *Tylenchus devastatrix*, the same Nematoid worm which is the cause of the ‘ Stockkrankheit’ of the Rye and Buckwheat in Germany and the Netherlands, and very probably of the Tulip-root in Oats. You will oblige me very much by informing me whether the foregoing crop was Tulip-rooted Oats. Miss Ormerod has sent me Clover plants (Clover-sick) from land where previous Oat crop was destroyed by Tulip-root, and I found a great quantity of *Tylenchi* in them.”

In the course of the latter part of April and beginning of May Mr. John Elder, of The Holmes, Uphall, Linlithgowshire, forwarded me specimens of Clover plants which he had noticed were not thriving when he was top-dressing the field a fortnight before. “ They were worst on the portions which failed through Tulip-root last year when in Oats.”

The mixture applied was sulphate of ammonia, four parts ; steamed bones, two parts ; sulphate of potash, one part. One and a half cwt. of the mixture per acre.

Specimens of these were forwarded to Dr. Ritzema Bos, in some of which he found decided infestation. Dr. Bos wrote me :—“ In Nos. 3 and 4 I found *Tylenchi* in a considerable number ; males and females, larvæ and eggs. In No. 3 I found a great number of *Tylenchi* in the

lower part of a branch of a Clover plant, which in the centre was dying also in the infested buds. In No. 4 I found them in the inflated buds only."

(The plants marked No. 3 were noted by Mr. Elder as "unhealthy plants grown on undrained land at the end of field, after Oats destroyed by Tulip-root. Oats after Turnips manured with farmyard manure" and those marked No. 4 were "unhealthy plants grown on land not very well drained, where preceding Oat crop was destroyed by Tulip-root." Oats after Turnips, town manure, consisting principally of ashes and farmyard manure.)

Other specimens were subsequently sent by Mr. Elder, in commenting on which Dr. R. Bos made the following remarks:—"I think it to be evident that this form of 'Clover-sickness,' 'Tulip-root' in Oats, the 'Stem-disease' in the Rye, the 'Ring-disease' in Hyacinths, &c., are all caused by the same parasitic Nematoid worm, *Tylenchus devastatrix*, for the worms found by me, sometimes in a large number, in the Clover plants were *T. devastatrix*; those found by me in Tulip-rooted Oats were *T. devastatrix*; and in Clover-sick plants grown on land where previous crops were Tulip-rooted Oats I found often the same parasite. In the plants of Mr. Elder, which were *not* grown on land where Tulip-rooted Oats had been the previous year, I found *no Tylenchi*."*

On July 8th specimens of diseased Clover plants were forwarded to me from the Experimental Farm, Woburn, by Mr. F. E. Fraser, in which the peculiar bulb-like deformation of the attacked bud or shoot, which often characterises *Tylenchus* attack, was very noticeable. Mr. Fraser mentioned that the ground from which these plants were taken was exceedingly hard, as there had not been any rain for the previous month.

On examining the specimens of Clover some of the stems with flowering heads were still to be found, but also there were a large number of short brown barren shoots about an inch long, oval in shape, and with the distorted growth of leaves now merely forming an imbricated or tile-like exterior. These shoots were placed closely together, apparently from the growth of the shoot having been stopped. They varied in number; sometimes as many as five grew on an inch length of shoot, one at the extremity and two at each side below, so as to form together a flat fan-like mass. I did not find they grew *round* the central stem. They were not all similar in form of diseased growth, but were commonly irregularly and oval or somewhat bulb-shaped, but sometimes they were much prolonged, so as to resemble what is known as a duck-necked onion in shape, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base.

* For further communications by Mr. Elder on Eelworms, see paper on "Tulip-root" on Oats.

In some instances the short brown deformed shoots had a little bit of deformed shoot or of leaf-growth proceeding from it. One of the shoots, which was merely swollen, not altogether shortened by disease, on being opened, proved hollow near the base, with decayed matter within, and also palish-brown powdery or rather damp granular matter; and, on placing this under an inch-power, it proved to be swarming with *Anguillulidæ*. Under a quarter-inch I clearly distinguished in some of these the presence of a spear with bulbous base. I also found *Anguillulidæ* in the short, brown, somewhat bulbous-like shoots, in the perishing matter in the centre of the short somewhat scale-like leaves.

On forwarding specimens to Dr. de Man for his skilled investigation, he replied:—"I have examined the Clover plants that you have sent me, and most plants, if not all, were found to be infested by numerous *Tylenchus devastatrix*, so that the occurrence of this dangerous worm ought to be regarded as the cause of the disease."

Dr. Ritzema Bos also replied:—"In the Clover-sick plants I have examined the deformations you so correctly describe, and I found *T. devastatrix* in them."

Dr. Ritzema Bos added the following information, which is well worth observation, as showing how plants completely different in kind, but all subject to attack of this kind of Eelworm, can both receive and convey the attack to each other:—

"I had sown some time ago Onions in sand, mixed respectively with Tulip-rooted Oats, Clover-sick plants, and Carnations, attacked by *Tylenchi*; and I found that the *Tylenchi* of each of these diseased plants attacked the Onions, and made them diseased in the same manner as the *Tylenchus* disease with which we are acquainted in the Netherlands; and, in sand mixed with decaying Clover-sick plants and diseased Onions, I sowed Oats, and soon the Oats became Tulip-rooted. Thus I have shown that not only morphologically, but also physiologically, there is no specific difference between the *Tylenchi* in Clover-sick plants, in Tulip-rooted Oats, in 'Pine-apple' diseased Carnations,* and in diseased Onions."

* "Pine-apple" diseased Carnations.—This peculiar form of growth had been so marked in some specimens of diseased Carnations which I had recently forwarded to Dr. Ritzema Bos, that I had suggested this name as convenient for describing the appearance of Carnations attacked by *T. devastatrix*, just as the word "Tulip-root" is used to describe Oats with this outward manifestation of presence of this Eelworm. It may be of interest further on to mention that in my own experiments as to infestation I sowed Turnips over Tulip-rooted Oats, torn small and buried in the soil, into which the seedling Turnips presently shot; and, on submitting these to Dr. de Man, he found one Turnip was infested with the *Tylenchus devastatrix*, but I was not able to continue my experiments on account of being then removing to a new home.—ED.

From the above investigations it appears that, though disease and decay occur in Clover from many causes, in the various cases examined into, where there was true "Clover-sickness," there also was to be found the presence of this particular kind of Eelworm, the *Tylenchus devastatrix*; and, in the cases of disease so advanced as to have a marked state of deformity of growth, there the Eelworms were markedly present.

From various circumstances—and, amongst these, especially from the suitable nature of the soil to the plant—it is possible for Clover to go on growing year after year on the same land, and still to thrive; but if the Eelworms are once established in land there is difficulty in clearing them, because not only of their immensely long-livedness, which extends over a period of several years, but also that they have the power of leaving infested plants and remaining in the field-earth; and further, that the one kind under consideration infests a very large number of crop and weed plants.

This puts treatment of this attack under different principles to that of most insect attacks, for the application of ordinary chemical manures will do good by killing the Eelworms frequenting the surface of the soil, even though these manures may not be what are more especially and technically, so to say, used for Clover.

As far as one experiment can show, that detailed above of the application of a top-dressing of sulphate of ammonia, sulphate of potash, and steamed bones did well, this being followed up by 2 cwt. per acre of sulphate of ammonia. In this case the result was so luxuriant a growth that in a little more than a fortnight after the second dressing the unhealthy plants (if any remained) had ceased to be noticeable. The fact of the land under consideration being deficient in potash may have to do in this instance with the addition of potash, mixed with other manure, being of marked service, as noted by Mr. Elder also in the case of Tulip-root in Oats; and, if a manure can be chosen at once pernicious to the Eelworms and beneficial to the Clover, this would be highly important.

It appears, so far as I can judge, a case in which dressings of gas-lime would be likely generally to do good. Gas-lime is utterly poisonous to the life of insects and similar small organisms, and applied with requisite care, as to amount and condition, would, I believe, be excellent for the Clover; in my own very limited experiments I have found an excellent growth follow on the application.

Where a field of Clover is so ruined by "sickness" that it has to be done away with, the infestation would appear to be necessarily done away with afterwards, if it was feasible to *pare*, collect, and burn the parings, and dress the exposed surface immediately before turning or further disturbing it with fresh, still caustic, gas-lime. In this way

the infestation in the Clover would be perfectly destroyed, and that on the surface of the land where the Eelworms which had left the plants were (or probably still were) lying would be got rid of, and subsequent ploughing and operations in due order, giving, of course, the requisite number of weeks for the gas-lime to oxidise and become harmless, would be treatment apparently suitable to all points of the case.

To put in Clover after Tulip-rooted Oats, or Oats after "Clover-sickness," or any crop liable to infestation after one suffering from Eelworm, is manifestly undesirable, and, where nothing else can be done, a deep ploughing with implements fitted to take off the first land-slice separately and bury it well down, is a thoroughly good measure.

It is also to be remembered, as a most important point, that this kind of Eelworm can be passed through the cattle feeding on plants infested by it without injury; therefore, manure from cattle fed on infested Clover is greatly to be mistrusted for application to Clover crops or Oats.

For further notes on the subject of Eelworms, likewise for figure of nearly-allied kind of *Tylenchus*, see paper on "Tulip-root," and references in Index.

CORN.

Frit Fly. *Oscinis frit*, L. (? *Oscinis vastator*, Curtis).



OSCINIS VASTATOR.

Perfect fly, nat. size and magnified; and attacked plant, with maggot inside.*

* The *Oscinis vastator* of Curtis bears such a strong resemblance to the *Oscinis frit*, which is the subject of the present paper,—even if it is not absolutely the same,—that I have used Curtis's figure to give the appearance of the insect and its method of injury.

On June 21st a communication was forwarded to me, by direction of Mr. Chamberlin, regarding some stems of Oats injured by insect-attack, which were sent from the Hill Farm, Stratton Strawless Hall, near Norwich. It was mentioned "that the specimens were taken from a field of sixteen acres, part grown with Tares and part with Oats; the soil is loamy sand, with gravel subsoil. A fortnight back we noticed a few roods of them dying off, and now about three acres are affected; and I find, on examining them, that there is an insect to be found inside the stem against the first *joint* from the root."

On examining the plants I found a small legless maggot, which was clearly that of a two-winged fly, and which was furnished with two large breathing-pores or spiracles near the head, and had also two tubercles or wart-like spiracles at the end of the tail. I fastened up the plants securely, and in less than a month plentiful numbers of a little black, brightly-shining, two-winged fly made their appearance. These were only about an eighth of an inch in length, and were very observable from their habit of skipping in all directions.

Samples of these flies I forwarded, in order to obtain their name with perfect certainty, to Mr. R. H. Meade, of Manningham, Bradford, Yorks., who was good enough to examine them, and replied that they were well-marked examples of the *Oscinis frit*, L.

During the last season I only received two notes of observation of this kind of attack, but, as I have reason to believe, from observation in previous years, that the attack is not uncommon to various kinds of corn plants in the spring, and sometimes does a good deal of mischief, it may be as well to draw attention to it.

The method of life* is said to be for the female to lay her eggs singly on the under side of a leaf. The maggot from these eggs creeps into the heart of the young plant down to the collar, and gnaws the youngest leaves at their base down to the centre of growth, and so destroys the terminal bud of the shoot; and, when this happens, further development is checked, and, where the plant is running up to stalk, the damage is especially perceptible from the yellow or reddish colour of the leaves and the weak growth.

When the maggots are full-fed, about the beginning of June, they penetrate through the sheathing-leaves, and change to chrysalids beneath the outermost or next to the outermost of these.

The attacks which I have seen in various years correspond with the above description of attack in the winter and spring plant, and in the year 1881 I had specimens sent early in June from near Tewkesbury of young wheat plants much injured by attack of a small whitish grub furnished, as above mentioned, with two tubercles at the end of

* See 'Praktische Insekten kunde,' by Dr. E. L. Taschenberg, pt. iv., pp. 151—153.

the tail, and otherwise resembling the description given above, which developed to an *Oscinis*, either *frit* or indistinguishable from it. The damage in this instance was very severe, estimated by the owner at fifteen bushels per acre on nearly fifty acres of fallow wheat.

The exact nature (that is, the precise cause) of the above kind of injury to the young corn has been difficult to make out, as in the instances reported, though the mischief was much the same in all cases, it was plain there were two kinds of maggots present, turning to two quite distinct kinds of flies. One of these I have described above; the other, as I mentioned at length in my Tenth Report, was of a very differently-shaped maggot, small at the head-end and truncate at the tail, and turned to a small greyish two-winged fly (the *Hylemia coarctata*). Both of the above attacks appear so similarly destructive that at the present I do not see much to distinguish them by, as far as the plant is concerned, excepting that it appears that the maggot of the *O. frit* goes into chrysalis in the attacked plant, and the maggot of the *H. coarctata* is considered, either usually or in some instances, to leave the plant and go into chrysalis in the ground.

With regard to prevention, we do not seem at present to have a clue as to how to prevent attack on *spring-sown* Wheat, or on the Oats and Barley, for we do not know where the flies which lay the eggs pass the winter; but it has been noticed that the attack particularly takes place to Wheat sown after bare fallow. If this Wheat was sown early in the autumn, whilst the flies from the summer brood were about, this would quite account for the attack taking place; and therefore it seems probable that, as with Hessian Fly attack, at least to autumn-sown Wheat, might be quite avoided by *late autumn sowing*.

In the course of the coming year I should be very glad to receive, for examination, heads of Wheat, Barley, or Oats, in which the grain may be observed to be deficient and small, accompanied by presence of small whitish maggot, which possibly might help us to knowing the summer form of attack of the "Frit" Fly.

The Hessian Fly. *Cecidomyia destructor*, Say.*



CECIDOMYIA DESTRUCTOR.

Hessian Fly, nat. size and magnified.

THE year 1886 was memorable, agriculturally, for the appearance of the Hessian Fly as a pest of the Wheat and Barley in Great Britain; and 1887 has shown it to be to all appearance settled in the country. Whether the fly had been present before last year we cannot tell, but we can tell very certainly that it was not *known* to have been present; and also that its attacks had not been recorded agriculturally; nor had the fly, the *Cecidomyia destructor*, Say, been entered in the lists of British insects.

There are several kinds of injury to growing straw,—some caused by weather, some by insects,—which, in their effect on the stalk, bear such a strong general resemblance to that of the Hessian Fly maggot that without careful examination it is almost impossible to tell the difference. Many such have been sent me during the past season, with the inquiry whether it was “the dreaded pest,” and, as in the many surmises sent me as to this attack having been noticed ten or twenty or even fifty years ago not one instance has ever been given of the “flax-seed” being found near the knots of the stalk, my own opinion certainly is that the attacks were of the same nature as those so generally mistaken for the Hessian Fly attack at the present day.

But however this may be, the case, as it stands now, appears thus: Hessian Fly made its first appearance as an acknowledged pest amongst us last year over a small area in England, and a larger and more scattered area in Scotland: this year the area of its presence has increased to a more or less broad band sweeping up the eastern side of the kingdom from Kent to Cromarty, and also present at some localities in the South of England but at the same time, although the weather has been what is considered exceptionally suitable to the

* This paper is a reprint, with additions, of my pamphlet, ‘The Hessian Fly in Great Britain in 1887,’ which was issued during the winter in order to give the reports of the past season as soon as possible.—ED.

insect, the damage has only here and there been to the amount that was to be feared from what has taken place in other countries.

No damage has hitherto been reported on the *young* Wheat or Barley; the accounts of attack are limited to injury to plant when running up in stalk, and in this condition, although much injury has in some cases occurred to Barley, Wheat appears to have done what is called "resist" attack, and strong firm stems of good sorts well cultivated not to have elbowed down, or to have suffered but little under the attack of the pest.

In the following pages I have endeavoured to class the information sent in during the past season under the following heads:—

First appearance of the perfect fly (male and female) from "flax-seeds" preserved from last autumn's British crops.

First appearance of attack on the crops.

Observations of appearance of the pest on Wheat and Barley, which I have arranged in order of date, and under the heads of the countries in which they occurred, *viz.*, England and Scotland.

Observations on other points which have been investigated, as examination of imported straw and sweepings of ships; non-presence of Hessian Fly attack on Oats; information regarding the species of parasites which have been identified as found in Britain; kinds of Wheat which have been reported as not suffering much under attack, &c.

These observations are arranged for convenience of reference under their respective headings, and two maps are added, showing the districts known to be infested both in England and Scotland.

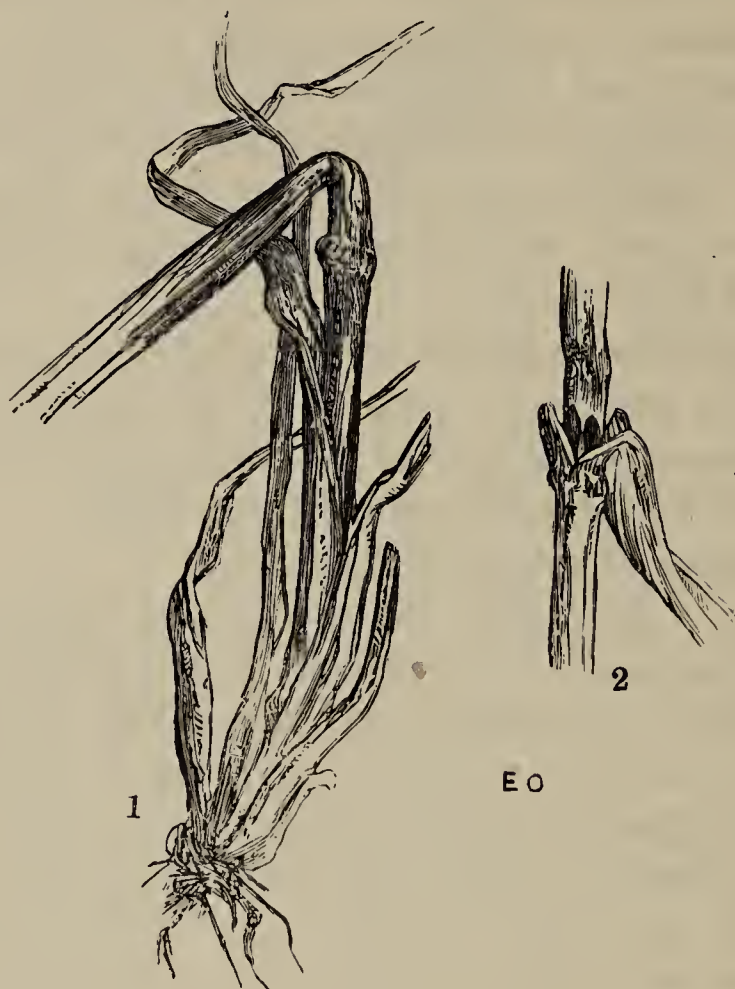
LIFE-HISTORY OF HESSIAN FLY.

For such as may not have studied the nature of Hessian Fly attack, it may be desirable to mention that where the attack occurs (as it mostly does with us) to the growing stalk, the white legless maggot feeds *outside* the stalk, but *inside* the leaf-sheath just a little above one of the knots. Commonly it is just above the second knot, but the attack may occur lower down at the first knot, or close to the root, or higher up above the third or fourth knot.

The mark of attack being present is the stem elbowing sharply down just above where the maggot lies. It does not commonly break, but, unless the straw is very firm, it bends at the weakened spot, and thus damage is caused to the fallen head, besides difficulty in reaping from the confused state of the straw.

It appears from Dr. Lindeman's careful observations in Russia that the larva (or maggot) lives about twenty-eight days in this condition. Then it changes at the precise spot at which it fed to a

brown flat chrysalis, in size and shape and colour strongly resembling a rather small and narrow flax-seed, whence the name of "flax-seeds"



Attacked Barley-stems. 1, elbowed down ; 2, showing "flax-seeds."

is commonly given to these chrysalis-cases or puparia. Within this hard outer husk the maggot changes to chrysalis, and the chrysalis to the perfect fly, but how long this may take depends very much on circumstances. It may occur, under natural



E O

"Flax-seeds" or puparia in different stages of development, nat. size and mag.

and favourable circumstances, so soon that the whole time occupied in the life of the fly from egg to development is only forty-eight days ; but it has been shown that if the *puparium*—to give it the precise name—is put in unfavourable circumstances, development may be greatly retarded. Thus some of the flies may come out in autumn in the fields, and others threshed out, or stacked in the straw, or kept artificially for investigation, may very likely not hatch until

May, or much later in the following year. The perfect fly much resembles a stout-made little brown gnat, about one-eighth of an inch in length, with one pair of smoky-grey wings, and with long horns.

For those who desire a full and trustworthy scientific description of the fly (that is, the imago of *Cecidomyia destructor*, Say) I append the technical account of both male and female by Mr. R. H. Meade,

of Mount Royd, Bradford, from *living specimens* (published in the 'Entomologist' for July, 1887). The specimens were bred by Mr. Inchbald from "flax-seeds" (or puparia) forwarded by Mr. D. Taylor, jun., from his farm of Daleally, Errol, N.B.

CECIDOMYIA DESTRUCTOR, *Say*.

Thorax niger. Abdomen carnosum, femina maculis nigris quadratis disjunctis, mare confluentibus, signatum. Antennae 17-articulatae, mare petiolatae, femina sessiles. Epistoma cirro nigro instructo. Pedes testacei nigro-hirti. Alae nigrescentes, radicibus rufis. Long. mas. 2, fem. 3 mm.

FEMALE.—The female being the larger, more abundant, and more characteristic sex, I shall first describe it, and then mention the distinctive points of the male.

Head. Eyes, with forehead and occiput, black, the last clothed with thick and strong black hairs. Epistome prominent, and furnished with a tuft of black hairs. Palpi yellow, the four joints being partly covered with black scales, which are more numerous on the second than on the first and third divisions, and entirely cover the terminal joint. Proboscis very small, and of a pink colour. Antennae rather more than a third of the length of the body, yellowish brown, consisting of seventeen joints shortly verticillated with black hairs. The two basal joints are nearly twice as thick as the others; the first is club- or rather cup-shaped; the second nearly globular; the next are all smooth and cylindrical (turning irregular in size and shape when dry), about twice as long as broad, becoming gradually rather smaller towards the end, and terminating in an elongated tapering joint, which is about half as long again as the one before it. Collar or neck pinkish yellow.

Thorax black, with grey reflections, having a few scattered white hairs on the sides, and two indistinct lines of thinly placed white hairs along the dorso-central region. A pinkish red irregular-shaped streak or patch runs from the side of the neck along the lower side of the thorax to the base of the wing. *Scutellum* black, prominent, and crested with black hairs. *Halteres* pale red, irregularly clothed with patches of black scales.

Abdomen pinkish or yellowish brown, with eight segments; the first is nearly black: all the others are marked on each side of the dorsum with a large square velvet-black spot, which spots are separated by a considerable longitudinal space from those on the opposite side on all the intermediate segments, but become nearly confluent on the seventh and eighth joints. A single row of similar large square spots runs down the centre of the ventral surface. The oviduct consists of three joints; the basal one is thick and rounded, the second and third are cylindrical, the last one being of about half the diameter of the second, pointed, and without lamellae. They are all pale red, the terminal one being brown at the tip.

Legs pink, becoming brownish yellow after death, clothed irregularly with black scale-like hairs, which are generally thicker in the neighbourhood of the joints. The coxae are brown, the short fore femora or trochanters black, the others yellowish brown. The ends of the tarsi and fore tibiae are generally darker than the other parts.

Wings pink at the roots, and clothed with black hairs; the second longitudinal vein runs nearly straight until near its extremity, when it curves slightly down and reaches the border of the wing a little above (or before) the apex. The third longitudinal vein gives off its descending branch in the usual way, which reaches the hind margin of the wing at a point exactly opposite the termination of the first longitudinal vein.

MALE.—The male insect differs from the female by being about one-third shorter

and much more slender. The antennæ have the same number of joints (seventeen), are pedunculated, and proportionally longer, being about two-thirds of the length of the body. The joints are ovoid in shape, becoming nearly globular towards the end. The terminal joint is not longer than the others, as in the female. The stalks are about half as long as the joints. The verticellar bristles are much longer than those in the female, and white in colour. The tuft of hairs on the end of the scutellum is also white.

The *abdomen* is almost black, with a pink extremity, but is really marked in the same way as the female, with large square black spots, only being very slender they coalesce; thus the two lateral rows cover the dorsum, only leaving a narrow pink line down the centre, which is sometimes indistinct, and a pale streak across the edge of each segment. The spots on the ventral aspect hide the underlying colour altogether. The last joint of the abdomen is of a pale pink colour, and is provided with a pair of claspers or forceps of a brown colour, between which are seated the generative organs, the peculiar structure of which is now found to be of great importance in the determination of nearly allied species among various insects, but which it is very difficult to describe without the aid of figures. Two thick blunt processes, which project forwards, are placed between the roots of the forceps, each of which has a small rounded eminence on its extremity. Beneath and behind these, occupying a central position, is an elongated tapering organ extending nearly to the joints of the claws of the claspers, which is flanked on each side by a flattened hairy process with a dilated extremity. These organs are of a pink colour.

The *legs* are rather paler than those of the female; the fore coxæ are pink.

The *wings* are proportionably longer than in the female, and less nigrescent. Mr. Inchbald tells me that when they are first expanded, "a ruddy tinge is observable throughout the wing." This is less conspicuous in the female.

R. H. MEADE.

1, Mount Royd, Bradford, June 15, 1887.

The above is given by kind permission of Mr. R. H. Meade, and also of Mr. Newman, proprietor of the 'Entomologist.'

FIRST APPEARANCE IN 1887 OF THE HESSIAN FLY FROM "FLAX-SEEDS,"
OR PUPARIA, TAKEN FROM THE PREVIOUS YEAR'S CROPS AND PRESERVED IN ARTIFICIAL CIRCUMSTANCES FOR SPECIAL OBSERVATION.

The following notes of observation of the puparia, or "flax-seeds," of the Hessian Fly, up to the hatching out of the perfect insect, with which I was favoured by Mr. Peter Inchbald, of Fulwith Grange, Harrogate, are of much value, as coming from one so well known as a special observer of the Cecidomyiæ. It will be seen that these notes give the change in the appearance of the "flax-seeds" which occurs just before the fly hatches out from them; the time of day at which the hatching out takes place; the proportion of males to females; the duration of the life of the flies; and likewise the many weeks over which the successive appearances of these flies (that is, scientifically, the imago of Cecidomyia destructor, Say) extended. To these are added notes of appearance of the Hessian Fly in captivity, respectively a few days earlier and a few days later than recorded by Mr. Inchbald, namely, in the first case on or about May 18th,—certainly before

May 20th; and, in the second case, on July 20th, which is the latest observation given of appearance from the preceding year's puparia.—ED.

On May 3rd Mr. Inchbald wrote:—"I had hoped long ere this to have sent you types of *Cecidomyia destructor*; the cases are very brown. I feel some moisture is essential to their development. All the Cecid group are lovers of moisture."

May 9th: "As I told you, the pupæ of *C. destructor* are gathering intensity of colour daily."

No further progress of alteration of appearance was mentioned until May 27th, when Mr. Inchbald wrote:—"My pupa of *C. destructor* has turned very red,—*glowing*: its eyes are to be seen and its antennæ; legs are all folded in their sheathing covers waiting extrusion"; and two to three days after this change the Cecids (that is, the Hessian Flies) began to appear out of the "flax-seeds" or puparia.

On May 30th Mr. Inchbald wrote:—"I have reared three *C. destructor*, one male and two females. The male emerged on May 29th, and the two females on the 30th (this morning). They begin their winged life very early, I expect about sunrise; at all events, the perfected existence is attained before six o'clock. An early riser must he be who intends to look on the whole transformation-scene from the crack first made above the thorax to the drawing out from the sheath of the body of the gall-gnat. I have the little silver shroud, too, in itself an object of beauty, protruding from the puparium like molten silver, and the tracings of the little form that it has served to shelter so long are all there. I have examined both the male and female very closely; little, if anything, can be added to your wonderfully accurate engravings. The ovipositor is of great length, telescopically formed; the colour is deepest at the abdomen, fades gradually away as it reaches the tip."

On June 1st Mr. Inchbald forwarded me a specimen of the male *C. destructor* which he had reared, in excellent condition, together with the pupa-case and the "shroud" or light film which had enveloped it (the imago or perfect fly) now protruding from the pupa-case, and thus proving the development of the Hessian Fly to take place from these "flax-seeds" or puparia, and from nothing else.

Mr. Inchbald had now (June 1st) bred two males and two females from British "flax-seeds." By June 23rd he had reared twenty-one specimens (six only of them male); by July 1st he had reared twenty-five in all (seven males and eighteen females). Of these he noticed that they appeared early in the morning, and did not live for more than three or four days at the most.

Specimens of these Hessian Flies (or, to give them the full technical description, specimens of the imago of the *Cecidomyia destructor*, Say,

reared under Mr. Inchbald's own care from British puparia) were kindly distributed by him, so as to be in the hands of those especially interested in the matter, amongst whom were Prof. Westwood, Life-President of the Royal Entomological Society; Mr. R. H. Meade, our well-known eminent Dipterist, whose excellent description of both male and female has been given at pp. 15-16; Mr. Whitehead, of Barming House, near Maidstone (Agricultural Adviser to the Department of Agriculture); myself, and some others. There is therefore now no want of well-authenticated specimens of this new corn-pest, so placed as to be available for service.

On July 19th Mr. Inchbald wrote:—"The last I bred was a female on July 13th. Altogether I have reared twenty-seven specimens of *C. destructor*."

May 20th, Mr. D. Taylor, jun., of Daleally Farm, Errol, N.B., to whom we are all indebted for his long and carefully conducted observations on Hessian Fly, and matters connected with it, reported to me, on May 20th, that he had bred the perfect insect from his "flax-seeds."

On July 20th Mr. C. Whitehead wrote me, from Barming House, near Maidstone:—"I have found to-day a Hessian Fly, hatched from last year's puparia, in the bottle in which they have been since Christmas. . . . This proves that they will remain a long while in pupal form, and are more dangerous thereby. . . . I put moisture in the bottle about a fortnight or three weeks ago."

The above notes are of serviceable interest, as showing for one thing the effect of moisture in bringing about development of the fly, and, for another, how long development and the appearance of the fly from the puparium or "flax-seed" may be postponed, as these "flax-seeds" were collected from crops gathered in the preceding autumn. The protraction of time of development in non-natural circumstances is of some importance practically, and attention has been drawn to the point by Dr. Lindeman in his work on the Hessian Fly in Russia.—ED.

FIRST APPEARANCE OF HESSIAN FLY ATTACK ON BARLEY IN 1887 IN ENGLAND AND SCOTLAND.

The three following observations refer to the first records given of appearance of Hessian Fly in its maggot and chrysalis stage on the growing crops in 1887. The first observation was reported on July 7th, the second on July 11th, and the third on July 12th; the first of these observations being Scottish, the two others English.

On July 7th Mr. Pattullo wrote as follows from Eassie Farm, Meigle, N.B.:—"I have sent to-day a box with stems of Barley

affected with the insect I wrote about ; and I notice two of the specimens I send you are brown, and that the larvæ seem darker in colour than when I looked last.

“I am at a loss to understand how the fields have become affected, should this turn out to be an attack of the Hessian Fly, as the Barley was not dunged, and the dung applied to the Turnips the previous year was turned and heated, the mixture being half town’s dung and half farmyard manure.

“I have two fields of Barley affected, and I also saw a few stems in a field of Wheat. I may say I have only had three tons of foreign straw in the last few years.”

The above letter was forwarded to me on July 8th by Mr. Taylor, of Daleally Farm, Errol, with the following remarks:—

“I have just had some samples of Barley-straw sent to me, on which I find the larvæ of the Hessian Fly ; and I send by same post as this a few of the samples for your inspection.

“I have just written him saying that I have no hesitation in stating that his Barley is infested with the maggot of the dreaded Hessian Fly. I have as yet not observed any damage on our own crops, neither do I find any ‘flax-seeds’ on imported straw. I have reared one more fly, but plenty of parasites.”

On July 16th Mr. Pattullo forwarded specimens to myself, also from Eassie Farm, Meikle, Forfarshire. These I found to be of the Hessian Fly maggot (*i. e.*, larva of *Cecidomyia destructor*) in various states of growth or development, from the white shiny condition, or state just changing to the chrysalis, up to the complete change to chrysalis-case (*puparium*), or so-called “flax-seed” state, these “flax-seeds” being in some instances longitudinally striated. The attacked Barley was in very poor condition. Mr. Pattullo wrote accompanying:—“I send by to-day’s post specimens of the maggot infesting my Barley. . . . I think the attack is over, as I had some difficulty in getting the maggots in their earlier stages, as you wish them. I see a good many of the brown specimens shrivelled up, as if the recent rains had destroyed them.”

A few days after this (that is, on July 11th) very characteristic specimens of Hessian Fly attack, having the puparia or “flax-seeds” with the longitudinal striæ already beginning to show, were sent me from the Church Farm, Steeple Morden, Royston, on the border of Cambs. and Herts, by Mr. T. J. Hunt, with the remarks:—“I enclose specimens of Barley taken from a piece of mine. . . . The piece of Barley in question is after Tares, and is not a good piece ; and I find that there are more broken-down ones where the crop is weaker, though there it is not broken down very much.”

On the following day (July 12th) I received the following communi-

cation from Mr. G. E. Palmer, jun., of Revell's Hall, Hertford, who, it will be remembered, was the first observer of the attack of Hessian Fly in this country. Mr. Palmer wrote me:—"I am now finding a considerable number of pupæ of the Hessian Fly in our Barley, and fear that the attack will prove quite as bad, if not worse, than last year, and this notwithstanding the precautions we have taken to destroy the pupæ during the autumn and winter. The field in which I have found most is quite half a mile from where we had the attack so badly last year, and was Mangolds last year. I am afraid this dry weather is all in favour of the 'fly,' and I find that the hot dry ground is suffering most from the attack, as it did last year."

FROM THE MIDDLE OF JULY UNTIL THE END OF AUGUST reports were constantly transmitted of the appearance of the pest.

It is difficult to arrange these on any special plan, as they often contain information on very various points; and yet to separate these points one from another would destroy the value of the report. I have therefore, after the preceding notes of first appearance in England and Scotland, divided the others into English and Scottish observations, and arranged them according to date of appearance, with occasional notes to draw attention to points of especial importance.

For the most part they will be found to refer simply to note of attack, with date and locality; but some observations will also be found of amount of injury, names of variety of Wheat grown, effects of agricultural treatment, and also of the presence of the "flax-seeds" on the stem being sometimes above the first, third, or fourth knot, as well as above the second.

NOTES OF OBSERVATION OF ATTACK IN ENGLAND DURING JULY, 1887.

On July 15th Mr. F. M. Campbell, President of the Herts Natural History Society, wrote me from Rose Hill, Hoddesdon, regarding the pest under consideration:—"I am sorry to say that it is not only plentiful in Mr. Palmer's fields, but here also. Here I have found it in Wheat close to the root." And on the 19th Mr. Campbell forwarded samples of the attacked Wheat, with the note:—"Most of them are on the first joint, and one stalk has been visited both on first and second joint. It is evident most of the puparia about us in Wheat will be left on the field after reaping. . . . *C. destructor* may be said to infest our whole parish." And on the 26th Mr. Campbell added, "Hessian Fly to my knowledge is over the whole Hoddesdon, Ware, and Hertford districts."

July 16th. The Rev. W. Hopkinson, writing from Sutton, Wansford, forwarded specimens of attack on Barley, with subsequent

information, on Aug. 1st, that these were from Gidding, Hunts, and that he found it there in all his corn crops. And that "here also in Northamptonshire I find it in every crop I have examined."

July 18th. Mr. T. P. Brand forwarded a sample of attack from Brook Hall, Foxearth, Long Melford, with the note that, if these were pupæ of Hessian Fly, "we have got plenty of them on my farm at Foxearth, and also on my Shimpling Hall farm, seven miles distant, in the county of Suffolk." The "flax-seed" in this case were found on Wheat, and on Barley also, and the crop was very much damaged. It had a root-fallen appearance, and the ears on the affected stems were dead and the kernels shrivelled up.

July 18th. A note was sent me from Beauchamps, Buntingford, Herts, by Mr. Robert Pigg, of a small white maggot with a green spot on it near one end, which he found in a piece of Barley. This maggot, being situated "under the flag eating into the stalk,"—on a sample of the attack being forwarded to Mr. Palmer,—he returned reply to the sender, "I am afraid there is no doubt but that the insect you sent me is the larva of the Hessian Fly." [The green mark often to be found along the upper side of the Hessian Fly maggot is caused by the green juice of the food it has eaten showing along the food-canal.—ED.]

On July 19th Mr. F. I. Hunt, who had, as above mentioned, sent me specimens of attack to Barley on the 11th of the month, forwarded (also from Steeple Morden, Royston) specimens of Hessian Fly attack on Wheat. He also mentioned, "I find the Hessian Fly slightly in very many pieces of Barley,"

July 20th. Mr. Palmer forwarded me, from Revell's Hall, Hertford, the following notes of the advance of the attack:—

"Since my return I have made a further examination of our corn, and I can see that the damage caused by the Hessian Fly has considerably increased, and is quite as bad, if not worse, than last season; this is in the Barley.

"I also find a small amount of damage to the Wheat from the same cause, but not nearly to so large an extent as to the Barley. I have had a specimen of the larva sent me from a farmer at Buntingford, Herts, who reports that he had noticed a field of Barley was not looking well, and, on examining it, found some of the larvæ in the straw, which he feared was the Hessian Fly.

"Mr. Dorrington [of High Mead, near Hertford, a good and competent observer—ED.] also tells me that he has found pupæ in the fields near Hitchin, where he discovered it last year. I fear therefore that the attack is pretty general this year. . . .

"I was paying a short visit to Hampshire last week (near Petersfield), and took the opportunity of examining a field of Barley which

I passed through, and was not long before I found pupæ of Hessian Fly, but only a small amount."

July 23rd. Prof. Fream, writing from the College of Agriculture, Downton, near Salisbury, mentioned that, noticing the Barley in this neighbourhood was much bent at the second joint, he enlisted the aid of his students, and for the previous week they had been bringing in specimens of the Hessian Fly (of which samples were sent me) in the "flax-seed" state.

July 23rd. Mr. Arthur Smith, of Smallford, St. Albans, forwarded me specimens of Hessian Fly attack found by him in two Wheat-fields at Hill End Farm, together with some details of serviceable interest. Of three fields of Wheat contiguous to each other, amounting to fifty acres, one field (Clover in 1886, and sown at the end of October with Webb's "Challenge Wheat") had no attack. Of the other two fields, the part of No. 1 fallow in 1886, sown with Mustard, ploughed in, and sown with Webb's "Challenge" on Sept. 17th, had no attack of the Hessian Fly; but the remaining third (Swedes carted off and sown with April Wheat on April 12th, was mildly attacked. The remaining of the three contiguous fields (part fallow and Mangold, remainder Peas in 1886, sown with Webb's "Challenge" beginning of October), was more severely attacked. *Both pieces of fallow attacked were partly manured with London stable manure, portion of fallow not attacked with artificial.*

From the above note it appears that both the spring and the autumn-sown Wheat on the fallow were attacked where London manure was used.

July 24th. Mr. F. H. Cooke wrote from Deeping St. James, Market Deeping, Lincs., regarding a field of Barley attacked by the pest, of which specimens were forwarded:—"About one per cent. of the plants are bent sharply over above the second joint; some are broken right off. . . . I fear the attack is not confined to one or two fields, as, on looking in other crops in the neighbourhood, I find some of them attacked in the same way."

July 25th. Mr. Thomas Bunker, writing from Goole, forwarded specimens of the pest from a Wheat-field; and on August 1st further reported that he had found the chrysalids about a mile from the field first noted.

July 26th. Mr. H. Smith, writing from Sudbrook House, Ancaster, Grantham (with specimens of the attack sent accompanying), noted that he had found "a very large quantity" of the "flax-seeds" in his Barley. These were found just above the second joint of the Barley, which they had made knuckle-down. The heads of the corn, however, had not begun to shrivel up. The Barley was sown with seed obtained from Suffolk.

A few days later Mr. H. Smith further mentioned:—"The whole

of Ancaster is seriously affected. I had only time to examine one field at Grantham, eight miles off, and found it there. All the crops that I have examined are so badly attacked that one minute suffices to find it."

After examination the same day at Horbling (also in Lincolnshire), Mr. Smith noted that he found "flax-seeds" in two fields in about half a minute's examination.

July 27th. Specimens of attack to Wheat and Barley were forwarded to me by Mr. William Priestley, Offord Darcy, Cambs., with the note that he had found them that morning in the border of Cambridgeshire, a few miles from St. Ives.

On August 1st Mr. Priestley further reported:—"Since writing to you last week respecting the Hessian Fly, I have carefully gone over several Wheat and Barley fields on my farm, and find puparia in a state more or less advanced; in some cases the fly has gone. To-day I have been into five other parishes in this neighbourhood. Every field I went into similarly affected."

July 27th. Mr. John E. Thurnall, Royston, forwarded specimens of Hessian Fly attack on fields at Great Chishill, in Essex, about six miles from Royston. The fields infested, heavy land properly drained, and no foreign straw been used on the farm, which is $5\frac{1}{2}$ miles from a station; the land about 400 to 470 feet above sea-level, being nearly the highest part in the district. "The chrysalis seems always to be just above the second joint of the Wheat, and I am sorry to say there are many fallen stems, but just above the second joint."

July 28th. Mr. E. H. Riddiford, Sutton, near Sandy, Beds., sent me specimens of Wheat-stalks infested with Hessian Fly. He had found it in two fields of Square-head and Browick Wheat: and on August 1st he further mentioned that since writing he had found "flax-seeds" in corn of two of his neighbours (Wheat and Barley), and heard of it being found at more than one locality in the immediate neighbourhood.

July 28th. Mr. J. W. Poynter forwarded sample of Hessian Fly attack to his Wheat from Great Wackering, Southend, Essex.

NOTES OF OBSERVATION OF ATTACK IN ENGLAND DURING AUGUST, 1887.

On August 2nd Mr. Thurnall further reported from Royston, in continuation of his note of July 27th:—

"I have taken notice of various fields of Wheat and Barley in this district, and I find the 'flax-seed' Hessian Fly chrysalis in nearly every field. It appears in the following parishes in Cambs.:—Meldreth, Foulmire, Duxford, Ickleton, Trumpington. Essex: Chrishall, Heydon, Great Chishall. Herts: Barley, Reed, Therfield,

Royston." [some Barley-straw was enclosed with chrysalids at the third joint.—ED.]

Mr. E. Blundell, writing from Birchmoor, Woburn, on Aug. 3rd, informed me that he had then only seen three specimens of "flax-seed," but would search more carefully and report if he found them or the larva in any number.

August 5th. Mr. Herbert Fenning, of Bedford Estate Office, Bedford, forwarded me specimens of Wheat infested by Hessian Fly from one of His Grace the Duke of Bedford's farms at Cople, near Bedford. In this case the puparia or "flax-seeds" were mostly at the third knot, although some were at the second and fourth.

August 6th. I received specimens of puparia taken by Mr. F. E. Fraser, from some of the Wheat-plots at the Experimental Farm, Woburn. One of these "flax-seeds" was placed near the root, and the striæ running lengthwise along the chrysalis-case were very observable.

August 8th. The following communication was sent from Weldon Grange, Corby, Kettering, by Mr. J. Rooke, together with specimens of Hessian Fly "flax-seeds," some of which were placed at the fourth knot of the infested straw:—"I enclose herewith several plants of Barley taken to-day from one of my crops, sown February 15th, and growing on gravelly land. I fear they contain pupa-cases of Hessian Fly; they are the first I have seen, and I have not heard of them in this neighbourhood. You will observe that the grain does not appear to be materially injured."

August 8th. Mr. G. Cook, of Flitwick Wood Farm, Ampthill, Beds., forwarded specimens of "flax-seeds" on Barley, together with specimens of attack of *Chlorops*, noticed under this head elsewhere.

August 8th. Mr. G. A. Saunderson, of Hook's Mill, Guilden Morden, near Royston (Cambs. and Herts), forwarded specimens, with the note that two of them "have the pupæ close to the root—so close, I think, if the stubble was burnt, unless first pulled up, the pupæ would not necessarily be destroyed. Three specimens of Wheat and one of Barley have the stem considerably shortened between the two knots, where the pupæ are to be found. . . . One straw contains a pupa two inches from the knot I note the fly is more prevalent in Wheat than appeared some time since; but, except in a few cases, not so much so as in Barley; in two pieces in this parish close to here in the occupation of J. G. Johnson, Esq., it took me, I think, an hour to find one. I note also in Wheat, as the ear gets heavier, the characteristic bend, as in Barley, is more prevalent. When I began to look three weeks since there appeared to be nothing definite to guide to the affected straws."

August 10th. Mr. L. B. Woodforde forwarded me, from the Park

Farm Office, Woburn, Beds., specimens of Hessian Fly chrysalids, which he had that day found in a Barley field near. He mentioned that "considerable damage had been done to the crop, especially where it was late sown. Most of the pupæ appear to be in the second joint from the ground"; and on August 12th Mr. Woodforde further mentioned that he had examined crops in several fields, and had no difficulty in finding chrysalids of the Hessian Fly, and, from what he could hear, the attack was very general.

August 10th. Mr. W. Smith forwarded specimens from Marsh House, Quadring Eandyke, of puparia found on Wheat growing on land in his occupation in the parish of Quadring.

On August 11th, Mr. E. Riley, late of Kipling Cote, Market Weighton (who had previously been assisting me in investigations regarding Hessian Fly), writing from the Weir, Hessle, Hull, gave me the first information of the appearance of Hessian Fly in that neighbourhood:—"I am sorry to tell you I have found Hessian Fly in two fields of Barley within a quarter of a mile of here, one of the fields in large quantities. It is about four miles from Hull and sixteen miles from Goole, but I cannot trace any manure as having come from Hull. I enclose a few specimens."

August 11th. The following note sent me by Mr. R. Stephenson, from Burwell, near Cambridge, remarks, as in a good many other instances, on the small amount of real injury caused by the attack:—"Since writing you I have found 'flax-seeds' in three other fields of Barley, all one or two miles from each other, and from the field of infested Wheat. In one case the field is three miles from the nearest field known to be infested and in another parish, (Swaffham Prior). In all these cases the 'flax-seeds' are so few that the injury to the Barley is scarcely appreciable. I had to look closely to find any elbowed-down stems. I am thus inclined to think the Hessian Fly is distributed more widely than is generally supposed, and that in places such as the above, where they are as yet few in number, they are not suspected, and so not searched for."

August 11th, or a few days earlier, I had report, with specimens of Hessian Fly attack, from Mr. D. D. Gibb, of Thorn Farm, Lymington, Hants, and the remark:—"I was struck with the fact, when first I observed the 'flax-seed,' that in most cases it was shrunken and empty. Whether from inhabitation of parasite or from the natural hatching of the fly, I could not form an opinion."

Bridgwater, August 11th. A single specimen of the "flax-seed" was forwarded from Shapwick, Bridgwater, by Mr. E. Mills, with the information that he had found it in a barton where a farmer was stacking his Wheat. He had examined a great many stalks afterwards, but could not find another. The crop did not show signs of injury

from presence of Hessian Fly attack. Mr. Mills forwarded me the portion of the stalk, with the puparium or "flax-seed" still adhering, for my inspection.

This is one of the instances in which it would be of much interest to know what occurs next year, following on this very slight appearance observed, as, in reply to further inquiry, Mr. Mills wrote me, on Nov. 2nd, that he had examined a great quantity of Wheat, and on a great many farms, but could not find any appearance of attack except in this one case.

August 12th. A sample of Hessian Fly attack on Barley-straw was sent by Mr. E. Whitfield from Goring Heath (Oxon), near Reading, with a note that he feared he had discovered the presence of the pest in two fields of Barley. "I had not noticed it during the growth of the corn, for, owing to the long drought and the Corn Sawfly, it had looked bad,—short in the straw and thin on the ground; but to-day, when placing it in the barn, I was struck by the peculiar appearance of some of the stems, and on examination soon found the 'flax-seeds.'"

August 12th. Specimens of Hessian Fly puparia (one "flax-seed" down near the root) were sent me from Glanmore Cottage, Stony Stratford, by Mr. J. Stebbing, with the note that they were found on Wheat in that neighbourhood. The Wheat-stems on which they were found were fallen, and the corn prematurely ripened. "In all cases the attack of the insect is made near the root of the plant."

August 12th. Mr. W. Formby forwarded specimens of Hessian Fly infested Wheat-straw from The Cottage, Morningthorpe, Long Stratton, Norfolk, with the information that there were many more in his field.

August 13th. Mr. John Norwood wrote from Balby Bourne, Lincolnshire, forwarding stalks of Barley containing what proved to be "flax-seeds" of Hessian Fly for examination, and the observation that if this was the case, "this district is very badly infected indeed. For the last week I have found it in every field of Wheat and Barley on the farms under my management, extending to about 900 acres, belonging to Lord Aveland. In the twenty-acre field of Barley, from which the specimens sent were obtained, they may be picked up at *every step*. Several of the fields are sown with clovers and grasses amongst the corn; therefore it will not be possible to follow the course recommended, *viz.*, to plough in the stubble, &c. I have found similarly affected stems in several fields on adjoining farms, and I fear, from the large quantities found, some of which are near the third knot, and will be carried away in the straw, that it will be impossible to contend against them."

Pieces of Wheat-straw, with Hessian Fly "flax-seeds" at the

second knot, were forwarded on August 13th from Brant Broughton, Newark, by Mr. Francis Shaw.

August 13th. Mr. Edmund Riley, writing from Hessle, Hull, noted having found presence of the pest on Wheat at Lockington, about twelve miles from Hull, and nearer the sea. The field was situated in the Carr. And on the 19th he further added :—" Since I wrote you about finding the Hessian Fly at Hessle, I have found it at Lockington Carr, about ten miles from here ; also Huggate, ten miles farther north (and quite on the wolds) ; again at Bridlington, near the sea ; so that it seems pretty well scattered through the East Riding.

On or about August 16th specimens of Barley-stray infested at the second joint were sent by Mr. J. C. Swann, from the Manor Grange, Long Stanton, Cambridge

August 16th. Mr. Alfred Blomfield forwarded, from Orange Hall, Gosfield, Halstead, Essex, some samples of Hessian Fly " flax-seeds " found on the stems of some Wheat which he was then cutting. One of these chrysalis-cases was empty.

August 16th. Infested straw sent from Swinhope, Great Grimsby, Lincolnshire, by Mr. F. Scorer.

On August 16th Mr. E. Whitfield, writing from Goring Heath, Oxon (near Reading), reported :—" I have found more of the " flax-seed," but only in the two fields mentioned ; they are about a mile apart, and not in any way connected " : and on the 19th forwarded some specimens collected from his Wheat-stubble at Goring Heath, showing the " flax-seeds " placed low down at the root.

The only note of attack which I received from Northumberland was sent me on August 19th, from Holburn Mill, Belford, by Mr. Henry H. Avery, with " flax-seeds " accompanying, mentioning that he had found the attack in a field of Barley on his farm. The stalk of corn attacked was broken down at the second joint from the ground, and when examined two of the " flax-seeds," of which samples were enclosed, were generally found.

On the 22nd of August Mr. Thomas Bunker, of Goole, reported, with specimen accompanying, that he had found the fly (mostly as a chrysalis, but occasionally as a grub) in five parishes, *viz.* Goole, Hook, Airmin, Rawcliffe, and Balne."

On August 22nd specimens of attack were forwarded from his farm at Thuxton, near Hingham, Norfolk, by Mr. Frank Oddin Taylor.

August 24th. Mr. Maxwell Lefroy, of Crondall, Hants, gave me a note of Hessian Fly attack being found on Wheat on a tenant's farm, although his own was free.

August 21st. Mr. E. J. Thynne, writing from Haynes Park, Bedford, noted :—" I have found the Hessian Fly in abundance in the

Barley on two farms in this parish (Haynes), and to a small extent in the Wheat. I have also found it in the adjoining parishes of Wilstead and Houghton Conquest."

On the 24th Mr. Thynne wrote further, enclosing specimens of puparia, and mentioned:—"I have found but few in Wheat, and I think they seem to attack the weaker stalks; but the ears of the stalks on which I have found them are not always small, and sometimes do not show any signs of being the worse for being attacked."

Mr. Thynne further noted that the straw was so very dry that the "flax-seeds" flew out very readily. This is an important point relatively to dispersion of the "flax-seed" at harvest-time.

On August 27th Mr. Inchbald wrote me that—"In looking through Wheat and Barley fields between Harrogate and Wetherby hardly a field had escaped the ravages of the Hessian Fly; indeed we found it, I may say, in every field but one,—that field had been swept by the wind so that it was difficult to 'spot' the affected culms. I noticed that the root—or rather, I should say, the collar of the plant—was more destroyed where it grew in alluvial soil. I often found as many as four cases *in situ* on the collar of such plants, not generally at the first or second knot, as was ordinarily the case where the soil was more friable. In some fields the plants were so affected that it is difficult to believe that two generations could have multiplied in so short a time; they gave the impression that they may have suffered from depredations which have spread over several years."

I also received specimens of puparia of Hessian Fly found in a Barley-field in Holderness, Yorks., from Mr. T. Barker, of Sproatley Rise, Hull; and later on (that is, at the beginning of November) I received information, with a sample accompanying, from the Rev. J. H. White, Weybridge Vicarage, Suffolk, of Hessian Fly having been found by Mr. C. C. Jacobson, of Weyland Hall, pretty well distributed over the parish, but that the attack was not considered to be serious.

OBSERVATIONS OF ATTACK IN SCOTLAND DURING JULY, 1887.

On the 15th July I received samples of a very decided case of Hessian Fly attack from the Editor of the 'North British Agriculturist.' In this instance the pest was present in advanced larval (maggot) stage,—white and parchment-like, save where a strip of green caused by the food imbibed showing through the skin ran along the grub. Some of the maggots were beginning to turn brown, and some thoroughly characteristic puparia were fully developed, with well-marked longitudinal ridges and furrows. By the courtesy of the Editor I am permitted to use the accompanying communication sent to him:—

“I herewith send you some stalks of Barley with caterpillar in them, which I fear is Hessian Fly. The field where they grew is on high ground, and has not got dung of any kind for sixteen years, the crop having always been sown with light manures. Last year the Turnips on it were a fair crop, and two-thirds of them were eaten on the ground by sheep, along with linseed-cake and hay made from natural grass. If this is Hessian Fly, how has it got there; the field being surrounded on three sides by grass and on the fourth by hill-ground, and no fly having been in the neighbourhood last year.”—(Signed, “STRATHMORE.”)

On July 21st Mr. D. Taylor, of Daleally, Errol, N.B., who was the chief and earliest observer in Scotland in 1886, as Mr. Palmer was in England, reported the reappearance on his land of the attack; and the following letter from Mr. Taylor shows the much more obvious condition of attack at Daleally at above date, in 1887, than in the preceding year:—

“I went through some of our fields yesterday, and I find the Barley much broken down, a great deal more so than was the case last year; even if one did not know about the system of the attack, they could not fail to be attracted by the vast number of broken-down stalks. I went through our barley last year, and tried to find out the reason of so many black *ill-favoured* heads, but there was certainly not much broken down; the attack must have taken place later than it has done this year. You may have observed that the specimens of stems I sent were many of them pretty strong, and bore a good head, and the point of attack was almost invariably just above the second joint. This year the attack I find is mostly above the first joint, the part below in some cases much decomposed, the stalk-growth seriously stunted and prematurely withered, the head only partially shot, and in many cases the whole stool dead.”

On July 25th I was favoured with the following note from Mr. Robert Carmichael, of Drumphin Farm, near Crieff, Perthshire, which is of special interest, as giving, besides notes of locality of attack in the Carse of Gowrie, particulars of the condition of attack at Drumphin, compared with observations taken on that ground in the previous year.

Mr. Carmichael forwarded specimens of the attack which he had found on the previous day “in one field of Wheat” and four fields of Barley on two farms on the Braes of the Carse of Gowrie, about four miles north from Errol, where so much of the “flax-seed” was found last autumn. I also to-day looked over our own and two adjacent farms, on each of which I found the Barley more or less broken down by the pest; on no field I examined did I fail to find it. There is this peculiarity in this year’s attack that I did not notice last year,—the

white bleached stalk lying flat on the ground, when pulled up comes away out of the socket with the "flax-seed" sticking into the side of the end, having been under the very lowest leaf at the root, others having been considerably up the stalk, and one being evidently hatched this season, there being only a thin skin left.

July 25th. Mr. J. Blythe Myles wrote from Pitcany, Bervie, Kincardineshire, with specimens accompanying, as follows:—"I enclose a few Barley-stalks, which I fear have suffered from the attack of the Hessian Fly. The stalks have the peculiar bend, and there are above the knots of the stem and under the sheathing something similar to small "flax-seeds," but longer in proportion to the breadth than what they are. There are a very great number of stalks like that among my Barley."

July 26th. Mr. Andrew Spence wrote me from Mountboy, near Montrose, N.B., with samples of the pest which he had that day discovered in a field of Barley:—"The field was manured with stable-yard manure last year to the turnip crop, but there was no foreign straw used. I notice it in a field of Wheat, but not to such an extent as in the Barley." Mr. Spence further communicated to Mr. D. Taylor that a field of Wheat belonging to him was slightly injured, but his Barley was terribly damaged.

Mr. D. Taylor wrote:—"I have found it on a good many farms in the Carse, and on highly cultivated land too."

July 29th. Specimens of attack both on Wheat and Barley were forwarded from Upper Tulloes, near Forfar, by Mr. David Osler, with the note that the attack had appeared on his farm:—"In a 25 acre field of most luxuriant Barley we have found it throughout all the field, but worst in some thin spots." A specimen was enclosed "from a very fine field of Wheat."

July 29th. Mr. James Rodger, writing from the Estate Office, Mertoun, St. Boswell's (Roxburghshire), forwarded me a few stalks of Barley unmistakably attacked by the Hessian Fly, and mentioned that he found that "many fields on our estate here were unmistakably attacked. One field of Barley is especially bad; and on the headland of the field this morning I had no trouble in gathering an armful in a very short time. This is the first attacked field that I have heard of in the Borders."

OBSERVATIONS OF ATTACK IN SCOTLAND DURING AUGUST, 1887.

The following note, recording wide-spread attack but with little damage resulting, was forwarded, on August 13th, by Mr. H. Lindsay Carnegie from Kinblethmont, Arbroath, Forfar, N.B., with specimens accompanying:—

“As far as I have examined the fields in this district, and from what others have told me, I should say that nearly every Barley field in this district of Forfarshire was infested; the Wheat is not so bad, and the *oat crop seems free*. The heads of grain do not seem any worse; they are quite full. Whether this arises from the harvest here being quite a month earlier, I do not know; but of course if the heads had to lie on the ground for a month, as in ordinary years, the grain in them would be spoilt. When first I examined the fields there seemed to me more ‘seeds’ than I found to-day, in each specimen. Either the fly has been hatched or the ‘seeds’ may have been shaken out by a gale of wind we had a few days ago. On the whole I think very little damage has been done this season, owing to the very early harvest.”

The following notes—by Mr. W. Gillespie, of Athelstaneford, Drem, and of Mr. J. Smith, of Bilsdean, Cockburnspath—refer to attack in the South-east of Scotland. “Cockburnspath is on the boundary between East Lothian and Berwickshire. Bilsdean is about a mile and half distant, on the sea-shore of East Lothian, and about sixteen miles S.E. of Drem and Athelstaneford, where the ‘Hessian Fly’ appeared on Mr. Gillespie’s Barley.”

With regard to damage from attack, Mr. W. Gillespie, writing from Athelstaneford, Drem, N.B., about August 12th, mentioned:—“My Barley is not much the worse, the grain itself is no worse, but where the heads are down the reaper may not pick it all up; the head on the damaged stalk to all appearance is as good as the others.”

August 13th. Mr. W. Gillespie forwarded me some more specimens of infested Barley-straw from Athelstaneford, with the note:—“My Barley is all more or less damaged with it, but not to a great extent, the crop being fully matured before the attack of the ‘fly.’ . . . I examined a field of Wheat yesterday to see if there was any ‘fly’ in it, but could find nothing.”

The following communications, at dates of from 13th to 28th of August, refer to observations of Hessian Fly attack in the S.E. of Scotland, and were forwarded by Mr. J. Smith, of Bilsdean, Cockburnspath, N.B.

In the first accompanying specimens of infested Barley, Mr. Smith noted:—“I have also noticed Hessian Fly attack in Wheat.”

On the 24th Mr. J. Smith reported more particularly that since writing he had an opportunity of visiting some farms lying high on the Lammermoors, probably as high as any where Barley is grown, and found them worse infested than those lying near the sea-coast:—“I still believe this attack extends over a much wider area than has yet been taken notice of.”

On the 28th of August Mr. Smith further reported that “The

attack extends at least the length of this estate (Dunglass), between eight and nine miles in Haddington and Berwickshire; otherwise the tract of fine land bounded on the south by the Lammermoors, ending in the sea at Fast Castle, and the sixth milestone on the road east of Dunbar. I hear of it on the farms westwards, but have no information south of the Lammermoor range, having seen no one likely to know lately from that district. The Barley being later thereabout, I may yet be able to get away before it is cut, as the affected straws are more easily picked up before it is stooked."

Reverting again to regular order of date, on August 13th Mr. J. C. Buckmaster (of Schools of Science and Art, S. Kensington) sent me specimens of straw from a field near Kirklands, Dunbar, N.B., rather badly infested, but of which the crop had not suffered.

August 16th, or about that day, Mr. Neil M. McFarlane, writing from Percy Street, Stanley, Perthshire, reported as follows (samples of attacked Barley were sent accompanying):—"A great many fields in this neighbourhood are infested; in fact nearly every Barley field has some of the pest in it, and the Wheat to a less extent. I have examined most of the fields myself, and some of them are very bad. One field in particular is so bad that one-third of the stalks are broken down. The specimens I send you were taken from two different fields. The Barley in both is strong and good, as you will see from several of the stalks. I find that the puparia are as common at the third joint as the second. Some of the specimens I send you show them at the fourth joint. On one field I gathered twenty infested stalks, and of these fifteen had bent at the third joint. On one stalk I found the puparia scattered all over the stalk. Some farmers here consider that they have got the pest along with foreign straw, while others consider that the hot dry season this year has rendered the crops more liable to it than formerly."

August 17th. Specimens of Wheat-straw infested by Hessian Fly chrysalids were sent me by Sir J. Stewart Richardson, from Pitfour Castle, Perth.

On the 23rd of August Mr. John Milne, of Inverurie, Aberdeenshire, reported as follows:—"I enclose specimens of pupa found to be common in the joint or second knot of Barley in nearly every field in Aberdeen and Banffshire. They seem of various sizes. It is hoped they are not the pupa of the Hessian Fly, for, if so, it has got a firm footing in the Barley fields of the North of Scotland." The specimens accompanying showed only too plainly that the chrysalids were true Hessian Fly puparia. On the 29th August Mr. Milne further mentioned:—"I regret that traces of this insect can be found in every field along the coast from Aberdeen to Cromarty, and inland for twenty-five to thirty miles. I enclose a few specimens of Wheat-

straw from Urquhart, Morayshire. So far the ravages are not extensive, not more than one straw in fifty being affected, and on these the grain is of fair quality." "In Aberdeenshire, Barley and a little Rye, besides Oats, are the only grain crops grown." "If the 'fly,' does much damage in the future it may be necessary, if Barley is to be grown at all, that it be sown as a second white or grain crop, without seeds, and the stubble ploughed down as soon as the crop is removed." "PS. I might have mentioned that I find a good many of the pupa-cases empty, showing that the perfect insect has already emerged."

August 26th. Mr. Robert Ironside sent me joints of Barley-straw, infested by Hessian Fly from Auchlassan Lumphanan, by Aberdeen, with the remark that, seeing many of the stalks kneed, he had examined and found the so-called "flax-seed," and likewise that he was "at a loss to know how it could have come there, as there was no foreign straw used, that he knew of, near the place."

OBSERVATIONS OF ATTACK IN THE SOUTH-EAST OF SCOTLAND
DURING SEPTEMBER, 1887.

On September 1st I was favoured, by Mr. Malcolm Dunn, of Dalkeith, with the following observations, which are particularly valuable from Mr. Dunn's knowledge of insect-life and great accuracy and skill in observation, which have been much assistance to me now for many years; and I would particularly advise study of these notes, for they appear to me to give, in condensed form (that is, in the observations of one district), no bad idea of what the nature of the Hessian Fly attack has been in the infested part of the country at large.—ED.

Mr. Dunn wrote as follows:—

"I duly received your letter of the 16th ult., and I have delayed replying till I should have had an opportunity of inspecting the fields in the district infested with the Hessian Fly in East Lothian, and also around this neighbourhood, to see if I could find any signs of it. I have gone over many fields in the district around here, extending from Edinburgh to Tranent in East Lothian, and from the sea at Musselburgh to Penicuik, and nowhere have I been able to find any indication of the presence of the Hessian Fly. I have been told by several farmers that they 'had it among their corn'! but on examining 'it' I always found some other insect at work (generally the Corn Fly, *Chlorops tæniopus*), but never the Hessian Fly. I am satisfied that it has not yet appeared in this district, or is so rare that neither I nor any of the keen-eyed entomologists about Edinburgh have been able to detect it.

“ I went down to Drem, in the centre of East Lothian, and spent a whole day traversing the country between that and Dunbar. In twenty-seven fields of Barley, which I looked into, I easily detected the work of the insects, and found them in the usual place on the straws in twenty-one of the fields. In four more of them, after a little careful hunting, I found a few specimens of straw infested with the ‘ flax-seeds,’ and in only *three* fields did I fail to find the insect, so that it may be said to be ‘ general ’ on the Barley in that district. I had little time to spare for a close search in the *Wheat* fields, but kept a watch on them as I passed along, looking into a good many, but not going far among the growing corn. In only two fields was I able to find the insect, and that on very few stalks next to Barley fields, which were rather badly infested. On the whole, I do not think it exists on the *Wheat* in the district to any serious extent. I am certain it is far from being so evident on the *Wheat* as it is on the Barley. The worst spot I saw did not contain more than a *dozen* infested straws to the *square yard*, carefully measured and counted. In fact the infested straws (or rather broken or bent straws, clearly infested with the puparia) seldom exceeded half a dozen, and on each straw the ‘ flax-seeds ’ varied in number from one to five ; generally two or three.

“ So far as I could judge from the appearance of the heads and the grains of corn, neither had suffered in *size* or *quality* from the attack. The straw was bent, and to that extent ‘ *damaged*, ’ but not more so than we see it often after a heavy storm of wind and rain ; and the *loss* from the *storm* in most instances would be far more than the loss from the Hessian Fly in this instance. So far as I can judge from what I saw in the Drem and Dunbar district, I believe the comparatively little damage done is owing to the late period at which the ‘ fly ’ began to multiply, and to attack the crops. The great heat we had in June would naturally give it a good start, but the Barley had nearly reached maturity in the end of July, before the attack *began in earnest*, if I may so term it. If this surmise is correct it is possible that our cold and raw or wet springs may always be effective in keeping the ravages of the insect within bounds in this country, by keeping back the attack to so late a period in the season as to make it comparatively harmless.

“ I do not hear of this insect being found at a *high altitude* nor in *wet districts*, but of course it has hardly been long enough in the country to spread over all the parts where it may be able to exist. In several fields, in the upper parts of this county, I have failed to find the insect after the most careful inspection. The attack seems at present to be confined to the low-lying districts in the East of Scotland, and in proximity to places where it might have been readily imported from countries abroad infested with the ‘ fly. ’ ”

NON-PRESENCE OF HESSIAN FLY ATTACK IN THE EXTREME NORTH OF SCOTLAND.

In regard to presence of the Hessian Fly in the northern extremity of the island, I applied to Mr. George Brown, of Watten Mains, Caithness, to whom I have been indebted for many years for observations, and who is perfectly competent to form an opinion on the subject; and on Sept. 10th he sent me the following reply:—

“I have been on the look-out, but have never come across anything bearing the slightest resemblance to attack from these pests; and am pleased to say, so far as I can learn, Caithness is as yet free from a visitation.”

I was favoured also by Mr. Jas. Johnston, of Ophir House, Orkney, in reply to my inquiry whether the pest under consideration had been observed in the Orkney Islands, with the information that he had neither seen the Hessian Fly nor heard of it there.

THE FOLLOWING PARAGRAPHS REFER TO THE ONLY OBSERVATIONS OF THE EGGS OF THE HESSIAN FLY WHICH WERE REPORTED TO ME; TO THE FIRST APPEARANCE OF THE HESSIAN FLIES FROM THE CHRYSALIDS OF 1887; AND TO THE VERY IMPORTANT MATTER OF THE IDENTIFICATION OF THE HESSIAN FLY PARASITES.

First observation of maggots reared from eggs laid by the Hessian Fly.

The only observations sent me on this head were by Mr. D. Taylor (previously quoted), who mentioned to me, on August 22nd, that he had secured a few Barley plants with maggots of the *C. destructor* reared from the eggs. These he placed in the hands of Mr. S. L. Mosley, of Huddersfield, and he also forwarded some plants, with eggs on them, to myself; but, though it may fairly be considered certain that the flies were *about in the fields* during August, it was not till some days later that the first appearance of the flies from chrysalids of the summer brood, which had been taken from the fields and kept in captivity, was reported.

With regard to *method of deposit of the eggs of the Hessian Fly* on the blade of corn, Mr. Taylor further observed:—

“The fly goes about egg-laying in a business-like manner, with its head towards the point of the blade and the ovipositor extended in a kind of semicircle to reach the concave surface of the blade. After it has laid one egg it takes a flight round the blade and alights again at almost the same place to repeat the operation, until a row of very minute specks of a vermilion-colour is laid along the centre of the

blade. I could not say that it laid more than two eggs at a time without a change of position, nor how many it laid."

FIRST APPEARANCE OF HESSIAN FLY FROM CHRYSALIDS OF THE SUMMER OF 1887.

The first appearance of the Hessian Fly from the "flax-seeds" of this summer's harvest was reported to me on Sept. 5th by Mr. Inchbald (in this case from a locality in Yorkshire). He wrote:—"I have bred one imago already from a field near Wetherby, and I take it to be the scout—the foremost scout—of the great army so soon to follow in its wake. I have two boxes full of pupæ, and these have not passed through the screening process. . . . The gnat reared is darker,—swarthier than those of the spring brood; it is a female, and I think slightly larger than those I have previously reared."

On Sept. 27th Mr. Inchbald further wrote that he had reared four specimens of the Hessian Fly—two males and two females—from pupæ obtained in August from the culms of Wheat and Barley in the neighbourhood of Wetherby. He observed:—"We find the nearest approach of the fly to the east coast of Yorkshire is Ellerby, near to Burton Constable. I have a *considerable* number of recently-gathered pupæ. I got them in the hope of being able to supply my many friends with living specimens before the winter. I now think they will keep in abeyance till May, if they be not pierced."

PARASITES OF THE HESSIAN FLY.

The parasites of the Hessian Fly, which we have at present observed in Britain, are the maggots of very minute four-winged flies, which lay their eggs on the maggot, or, it may be, on the chrysalis of the Hessian Fly, and, by means of the maggot from the egg preying on the pest in its early state, prevent large numbers of it reaching maturity.

The presence of these parasites is looked on in Hessian Fly infested countries as a very important help in keeping down the pest; and, on May 28th, Mr. D. Taylor noticed the greater proportion of parasites to "pest" developed from his puparia of Hessian Fly. In one bottle containing not more than fifty pupa-cases, at the above date, no specimen of Hessian Fly had developed, and about twenty-three parasite-flies had appeared.

That these parasites accompanied the Hessian Fly from the very beginning of the first observation of attack last year is plain (a specimen having been secured in September, 1886), and since then, as is well known to all readers of the agricultural or other journals, the

parasites have been notably observed to be present; and during the past season attempts have constantly been made, with greater or less success, to identify them, and thus, by finding whether they were of the kinds known to infest Hessian Fly in Russia or in America, to gain a clue as to whether it was from Russia or America that the attack came of the insect whereon they feed, *viz.*, the Hessian Fly.

Up to the end of October, however, no certain conclusion had been arrived at, as most of those concerned (so far as I am aware), and myself amongst the number, identified, or endeavoured to identify, solely from published description, without knowledge gained from personal examination of either American or Russian specimens. Our best guidance was from the information kindly given by Prof. Riley, Entomologist of the Department of Agriculture of the United States, who, after long and careful examination of British specimens, at which I had the advantage of being present, stated that none of those submitted to him appeared to agree with specimens of the kinds known to him as North American; and that the points laid before him regarding the attack inclined him to consider it of European rather than American origin. I also myself, so far as I could form an opinion in such a difficult matter, have already mentioned that one of the specimens appeared to me to agree in essential points with the Russian *Semiotellus nigripes*, Lind.

Under the difficulties of identifying from description alone, I forwarded a small collection of parasites (bred from "flax-seeds" saved from the infested corn of the year 1886 by Mr. D. Taylor, of Daleally Farm, Errol, N.B.) to Dr. Charles Lindeman, Professor at the Academy of Agriculture, Moscow, who has devoted much attention to the study, both practical and scientific, of Hessian Fly in Russia, and has especially studied and written upon the subjects of its hymenopterous parasites. These specimens Dr. Lindeman had the great courtesy and kindness to examine carefully, and on the 31st of October I received the following communication from him, announcing that four of the five kinds he had examined were Russian; and with his letter he also sent a small collection of Russian specimens, truly valuable for our British service. Dr. Lindeman wrote me as follows:—

"I now hasten to attend to your communication sent to me with the parasites of the *Cecidomyia destructor*, and I have found the following species:—

- " 1. *Semiotellus nigripes*, L.
- " 2. *Tetrastichus Rileyi*, L.
- " 3. *Merisus intermedius*, L. (var. *micropterus*).
- " 4. *Platygaster minutus*, L.

"Along with these Russian species I find an example of what I am inclined to consider to be the American *Merisus destructor*. At least, it

is distinguished from my *Merisus intermedius* by the form of the body and brown shanks, and agrees well with the description by Riley."

The first four of the above parasites being Russian kinds, points to our attack of the Hessian Fly, on which the maggots of these insects feed, being certainly in part from Russia.

Whether the presence of the *Semiotellus* (or, as it is now called, the *Merisus*) *destructor* of Say, points to some part of our attack coming from America, does not appear to me so certain, because, although this is without doubt an American insect, it has also, under the synonym of *Ceraphron destructor*, Say, been recorded as parasitic on the Hessian Fly in Germany; and therefore it appears to me that this parasite may have come to us either from America or Germany. *Therefore the case stands at present that it is certain that four of the five kinds, which have been trustworthily identified, are Russian, and it is very possible that the whole of the attack has come from the Continent of Europe.*

On the 22nd of November Prof. Riley further wrote me that he had given two whole days to the examination of Hessian Fly parasites reared from British puparia, together with a collection of specimens of Russian parasites sent him by Dr. Lindeman, with the result that all the conclusions he had previously arrived at were confirmed. I give the list (by kind permission) of the species identified by Prof. Riley, which it will be seen includes the four species noted above which I had forwarded to Dr. Lindeman, and which were named by him as Russian, and likewise three other Russian forms:—*Semiotellus nigripes*, *Tetrastichus Rileyi*, *Merisus intermedius*, *Platygaster minutus*, *Eupelmus Karschii*, and *Euryscapus senilis*, all species of Lindeman; likewise *Dacnusa senilis*, Hal. (not a Chalcid). Thus Prof. Riley remarks, "Every one of Dr. Lindeman's forms have been reared in England, but I should not have been able to speak so positively without his types, which he has been kind enough to send me."*

Those who desire the latest and fullest information regarding these parasites are referred to a paper by Prof. C. V. Riley, Entomologist to the Department of Agriculture of the United States, "On the Parasites of the Hessian Fly," published in the 'Proceedings of the United States National Museum,' 1885, pp. 413-422, one plate. Also 'Die Pteromalinen der Hessenfliege' (*Cecidomyia destructor*, Say), by Prof. Lindeman, Moscow, 1887.

* As I have Prof. Riley's kind permission to give the information with which he furnished me, it may be of interest to some of the Hessian Fly observers to mention that he considered the *Semiotellus nigripes*, Lind., would probably be found synonymous with *Entedon epigonus*, Walker; that *Euryscapus saltator*, Lind., was *Euryscapus Degeeri*, as determined by Mr. Marshall; and that there were great varieties in the forms of *Merisus intermedius*; but as I believe that we may look forward to aid from Prof. Riley's skilled pen and pencil in putting the whole series of British parasites in order before us, I do not add more from the short notes he has kindly given me.

As the difficulties of the past year have shown that it is almost impossible to name these parasites from descriptions alone, I do not add any; but it may be of use to mention that these parasite-flies are so small that it is almost impossible to distinguish the limbs with the naked eye, and that they may be known from the Hessian Fly by this possessing only *one* pair of wings, whereas the parasites have *two* pairs, excepting in the few instances in which these are abortive.

OBSERVATIONS OF ATTACK NOT BEING FOUND PRESENT ON OATS.

Somewhat previous to July 27th a note appeared in one of the Scottish journals to the effect that a field of *Oats* in Brechin district had been badly injured by Hessian Fly. As the *Cecidomyia destructor* has hitherto not been known to injure the Oat-plant, further information and specimens were requested, but nothing further, so far as I am aware, transpired on the subject.

Later on, that is, on August 11th, I received information from Mr. Thomas Bunker, of Goole, as follows, and desire particularly to draw attention to it relatively to it showing non-presence of the pest on Oat-plants, even when the Oat-plants and infested Wheat-plants were growing close by each other. Mr. Bunker is acquainted with the appearance of the "flax-seeds," and forwarded confirmatory specimens. He observed:—"I regret to state that further researches have shown the Hessian Fly to be firmly established in this neighbourhood. Mr. Riley, of Hessle, came here last Monday, and we spent a few hours visiting some of the fields infested.

"In one field crops of Wheat and Oats were growing side by side. We thought it a good opportunity for testing the statement that the fly does *not* attack Oats. I have since found many Wheat-stalks attacked within a foot or two of the Oats, but failed in finding it on the latter plant, though I spent an hour and a half in the search. The leaf or sheath of the Oat fits so loosely on the stem, compared with that of Wheat, that I think it does not give the necessary shelter and protection to the larvæ.

"Very little Barley is grown in this district, and I have therefore had no opportunity of examining it. A farmer told me yesterday that there was not a Wheat-crop on either of his farms (more than two miles apart) that was not infested. He farms 500 or 600 acres."

On August 22nd Mr. Bunker sent me the following further report, accompanied, as before, by specimens of the "flax-seeds":—

"On the 15th I again tested the non-presence of the Hessian Fly on Oats. I was at Balne, a small township nine miles from Goole. The crop consisted of Wheat and Oats mixed. I was able to find the chrysalis on the Wheat, *but in no case on the Oats*. I enclose two specimens."

The following observations were chiefly sent to me in reply to my inquiries as to amount of damage, and also as to varieties of Wheat which, though attacked, were little injured by presence of the pest :

On September 24th Mr. John Milne, of Inverurie, Aberdeenshire, favoured me with the following reply to my inquiry regarding Wheats which were found to “resist attack”:—

“You ask if I can give the names of some of the Wheats that have the attack of fly, but yet do not suffer severely. . . . There is now no Wheat grown in Aberdeenshire. In Morayshire the variety is chiefly ‘Square-head,’ a strong-strawed yellow Wheat. As far as my observation extended, I could trace the fly in each field by the bent stalks, but the damage so far did not seem to be great, as the bent heads seemed fairly filled with grain. In Aberdeenshire a good deal of Barley is grown, and also a six-rowed variety called ‘Bere.’ I have seen it stated that the ‘Bere’ crop was uninjured, while the Barley alongside was attacked; but I have been unable to confirm this by personal observation.”

Oct. 15th. Mr. H. Lindsay Carnegie, of Kinblethmont, Arbroath, replied:—“I found the fly in nearly every field of Wheat near me, but not to any serious extent. Wheat here is nearly all winter-sown, and of the white variety. I searched several fields of Rye, but found none at all in them, *nor in any of the Oat-fields*. Barley was decidedly the most affected of all the cereals. . . . From the very early harvest very little damage was done in reality, as the grain had filled before being cut over.”

Oct. 15th. Mr. John Norwood replied to my inquiries from Bulby, Bourne, Lincolnshire:—“The kind grown on Lord Aveland’s farms here is ‘Square-head,’ a hardy red Wheat. The field in which ‘fly’ was most numerous has been threshed, and yielded 38 bushels per acre, scarcely so much as I expected; but still a very fair yield for poor strong land. I certainly could not estimate the loss caused by ‘puparia’ at more than one bushel per acre.

“My opinion is, had the weather not been so dry and fine for ripening, the ears on broken-down stalks reclining on the ground would have suffered severely; but the absence of rain and the hot dry state of soil enabled broken-down ears to fill almost as well as the others, and almost, if not quite, as good quality of grain. In ‘rubbing-out’ grain from the broken-down ears I noticed little difference in quality compared with the erect ones, but a slight diminution in quantity, not being so well filled. Had the season been wet the deficiency must have been much greater. In a neighbour’s field in this parish, growing a largely advertised variety of White Wheat, I estimate the loss at a higher figure, certainly two to three bushels per acre; and I do so from having noticed the broken-down ears very badly filled. I may say I

have seen no Wheat this year that is what is locally termed 'root-fallen' or 'storm-broken,' and that the broken-down ears are solely attributable to attack by Hessian Fly.

"In a twenty-acre field of Barley, in which 'puparia' were very plentiful, being gathered at every step, I noticed none of the ears broken down were so large as the erect ones, or so well-filled; the crop is not yet threshed, but, judging from the quantity and appearance of attacked ears, there must be a deficiency of three bushels per acre. Many of the broken-down ears were left on the ground by the reaper, and not all gathered by the horse-rake."

On Oct. 10th, relatively to amount of attack, Mr. Riley mentioned as follows:—"I found it all over the East Riding of Yorkshire (more or less), especially in Barley; in many places it would have done serious damage had the attack appeared a month sooner; fortunately the corn had begun to ripen before it came. I noticed that on land well farmed, as also on warp land, the Wheat was little worse in the sample, and that many of the stalks of corn that had the 'flax-seeds' in had not fallen down, showing there was sufficient support to carry the ear on."

Oct. 18th. Mr. G. Palmer, Revell's Hall, near Hertford, favoured me with the following information:—"With regard to damage to the Wheat, I observed, both this year and last, that it was very slight, and one had to search about a good while to discover a stem injured or bent down. On the other hand, you can stand in the Barley and see ten or a dozen at once. I think there is no doubt that the stiffer the straw the better the attack is resisted. We had this year about twenty acres of the 'Square-head' Wheat, which grows a very stiff straw, and I was unable to find any injury done to it; while there was some (although very slight) done to a field of weaker kind of straw adjoining. I do not consider that we had so much damage done to our Barley this year as last, although there was a large amount of Hessian Fly puparia in the straw. I can account for this from the fact that we grew a Barley with a very stiff straw, and it was not till the grain was pretty well matured that the stems attacked gave way, consequently the Barley in the injured stems was of nearly as good quality as those not attacked. In future we shall always grow this kind of Barley."

Oct. 18th. Mr. J. C. Swann replied, from Manor Grange, Long Stanton, Cambs:—"The specimen I found and sent you of the Hessian Fly was from a Barley-field. I have just threshed the Barley out, and found it excellent quality, but the yield excessively poor. I may add, for your guidance, the land is wretchedly poor and foul, and will lie for a fallow next year. . . . I did not find it in my Wheat-crop at all.

The Professor of Agriculture, Hollesley Bay, mentioned:—

"The early-sown Barleys I have found to be more affected than those got in later—during the first fortnight in April."

Oct. 21st. Mr. D. D. Gibb, replying from Thorn's Farm, Lymington, Hants, gave some information well worth considering regarding effects of manures, as well as regarding kinds of Wheat. He noted, as his experience of Hessian Fly attack on the farm:—

“Barley may be termed the chief sufferer: in two Wheat-fields adjoining Barley affected I failed to find proof of Hessian Fly, but did of sawfly. These varieties of Wheat were stiff-strawed, *viz.*, Ambrose's ‘Stand-up White’ and Webb's ‘Square-head Red.’ The ground was well-manured also, top-dressed in spring with salt and nitrate of soda. This Wheat was after Clover-lea, second growth fed off with fatting sheep, afterwards receiving say about fifteen tons farmyard manure. One field sown with ‘Webb's Challenge White Wheat’ not after Clover, but getting quite as much (say twenty tons) farmyard manure,—did not get the top-dressing: this looked well and healthy, so far as my observation went, all winter and spring, but suffered severely from attack of Hessian and sawflies. The ground was a poor sandy loam lying close to the edge of the Solent, and the season was altogether too dry for it to produce a crop. Barley top-dressed in a similar way, and with kainite, superphosphate, and sulphate of ammonia, showed less sign of attack than where not top-dressed. I was therefore led to the conclusion that whatever manure causes vigour of growth and gives stiffness to the straw lends the plant strength to better withstand an attack, except in very bad cases, and when mixed with weed-seeds.

“Some stubble which could not be burnt at the time was carried into a yard and well trodden-in by fatting steers. I also have suggested the addition to this of gas-lime, which will at the same time render the mixture more pungent, and increase the manurial value.”

Oct. 24th. Mr. W. Gillespie, in reply, added to previous information from Athelstaneford, Drem, N.B.:—“My Wheat was in no way damaged; the variety ‘Square-head.’”

Oct. 26th. Mr. A. J. Whitcher, writing from Peckworth Manor, Stamford, said:—“I have not noticed any Hessian Fly in the Wheats; variety grown, ‘Square-head White Chaff.’” Some fields of Barley have been greatly damaged. I found the later-sown Barleys much more heavily attacked by Hessian Fly than the earlier-sown. I also found that Barley grown on land that was Barley the previous year was very much more attacked than the Barleys grown after Turnips and Clover.”

Oct. 27th. Mr. John Hardwick, Agent to Sir John Thorold, of Syston Park, Grantham, wrote in reply:—“The usual kinds of Wheat sown in this district are the ‘Square-head’ and the ‘White Chaff Red,’ but more particularly the latter; and have not heard of any case where they have been attacked by Hessian Fly. The Barley-crop has been attacked, but not to any appreciable extent, about here.”

Oct. 27th. Prof. W. Fream, writing from the College of Agri-

culture, Downton, mentioned that the Wheat in which he found the Hessian Fly on the farm was 'Square-head,' but no interest or trouble was taken generally in the neighbourhood, excepting by himself and students, and he inclined to think that the attack was light.

Oct. 28th. Mr. Francis Shaw, of Brant Broughton, Newark, amongst other points deserving notice, drew attention to the amount of Wheat which had been drilled early this autumn, a matter which will be very desirable to watch effects of relatively to possible encouragement thereby of autumn brood of Hessian Fly. Mr. Shaw notes:—

“Next year will prove to us if it is to be dreaded to the extent some writers represent, as there will be an abundance of Wheat-plants this autumn upon which it can deposit its eggs, for I never knew so much Wheat drilled so early as this year; in several fields where it was drilled in September the Wheat was up in a few days. The kinds of Wheat which resist the attack of the fly the best are those which grow a stiff reedy straw, of little value as food for cattle, such as the 'Golden-drop,' the 'Square-headed Red,' 'Chaff Red,' and 'Rivett's Red.' The Barleys which grow the stiffest straw, although a very coarse grain, are the 'Awnless,' Webb's 'Kinver,' and the 'Battledore.' Those who are farming a poor weak soil have the most to fear from an attack upon their Barley. Here, where the soil is above the average, it would have been a difficult matter this last season to prove a loss from the fly, although it was discovered in many fields. I looked for it in vain in fields growing the 'Golden Drop' Wheat. My reason for thinking we have had the fly in this country for some years is from having seen the Wheat lying in the same position, at an angle of twenty degrees different years, without knowing the cause.”

On Nov. 16th Mr. Andrew Spence, of Mountboy, Montrose, N.B., replied:—“Most of the farmers in this district sow white Wheat. Both they and the others who sow red Wheat agree that there has really been very little damage to the Wheat-crop by the fly.”

The following note, with which I was favoured by Mr. W. Formby, sent on Dec. 7th from Morningthorpe, Long Stratton, Norfolk, gives one of the very few returns I have been able to procure regarding amount of loss on attacked crop. Mr. Formby mentions:—

“I am now able to say my Wheats were very little damaged. I only grew one sort the name of which I know not, but it is a red Wheat growing a lot of straw of a very strong nature. All my Barley-fields were attacked by the fly, one field in particular yielding four sacks an acre less than the rest of the Barley I have threshed up to the present time. I may say the field named was drilled with bought seed, and grew a finer straw than the rest of my Barleys, which in this neighbourhood is known as 'Archer's Barley,' and certainly gives me the

idea of resisting to a great extent the attacks of the fly. ‘Archer’s Barley’ I have grown for several years, and find it grows a large quantity of straw of a strong nature (this might not be the case on lighter land); the grain also is large.”

NON-PRESENCE OF “FLAX-SEEDS” IN IMPORTED STRAW AND SWEEPINGS OF SHIPS.

With a view to ascertain whether the pest was being introduced on imported straw, careful watch was kept, and examination made, by qualified observers from time to time during the spring months, at Dundee, Leith, and Granton, Hull, Goole, and other localities mainly on the east of Britain. The search was carried on by opening out bales, examining sweepings of straw-ships, and also by gaining permission to have a watch kept at stables and other places whither the imported straw was conveyed for use.

Specimens of seeds, &c., were successively sent me for identification, so minutely resembling the flat seed-like chrysalis-case of the Hessian Fly as to show that the observers were well acquainted with the appearance of the so-called “flax-seeds,” but only one true specimen was found. This was on a corn-stalk *grown* in Belgium, which is singular enough, as Belgium is one of the countries which is considered to be free from presence of the pest.

I keep the various communications for reference, if necessary, but, as in some cases my co-operators did not, I believe, wish their names to appear, I only express my thanks here for a great deal of long-continued trouble taken to Mr. D. Taylor, jun., of Daleally, Errol; to Mr. Edm. Riley, of the Weir, Hessle, near Hull; and I have particularly to express my thanks to Mr. Halls (of the firm of W. Halls and Son, the large straw importers in Hull) for the courteous and very great assistance they have given in allowing the straw to be examined, and the sweepings of the ships saved for inspection, and in directing the men to give every assistance in their power. I am also much obliged to Mr. John Bennett, of Goole.

On May 18th Mr. E. Riley, who had bestowed much care on the subject at Hull, wrote, after some weeks’ attention and inspection:—“I have examined some thousands of bales of straw at Hull and Goole during the last four weeks, from Harlingen [in the Netherlands, Ed.], Dunkirk, Hamburg, Rotterdam, and Boulogne, but have not found the slightest trace of chrysalis of Hessian Fly.”

The stevedore at Hull [who was well acquainted with the appearance of the “flax-seeds”—Ed.] has taken great pains in having all the sweepings of the vessels thoroughly examined.

On August 12th, my co-operator, near Edinburgh, reported:—“I have been keeping a close look-out all the season for the dreaded

Hessian Fly, and a very close watch has been kept on all imported straw at Leith and Granton. Still we have failed to detect anything like the enemy in *this district*, or on the *imported straw*."

I give the above short abstract of the information forwarded to me to show the care that was bestowed upon the subject, and also that, from such a small body as a single puparium being found, and likewise the many specimens very much resembling "flax-seeds" which were sent me for inspection, it appears to me certain that if the chrysalids of Hessian Fly ("flax-seeds" as they are called) had been present, they would quite surely have been noticed. But at the same time I do not consider that their non-appearance militates at all against all possibility of infestation being sent us from *infested* countries, because (so far as we know) the straw we examined was mainly from countries where attack, even if present at all, is not prevalent.*

We have, however, learnt, from the minute and skilled examinations, the valuable practical point that a large amount of the straw coming into the country is not infested; and, with regard to what further may be needed, it appears to me that what is wanted (now that we know that Russian parasites to be present in the country) is for receivers of Russian straw (and corn, if not properly cleaned), and for their customers, to give due regard to the matter.

Attention as to consequences of using cheap, foul screenings is much needed. As far as one year's experience shows, Hessian Fly here is not so injurious as at least two other of our regular established corn-pests, whose attacks have been quietly submitted to for many a year without even an attempt worth speaking of being made to get them under. But I would most strongly urge on all agriculturists, and on all importers of grain, that they should insist on it being sent to them properly cleaned before shipping, and also that the sale of the foul rubbish teeming with insect-vermin, weed-seed, ergot, and useless dirt not even valuable as a manure, should be by every means discouraged.

METHODS OF PREVENTION.

Destruction of "flax-seeds" found (after threshing infested straw) in siftings or light grain.

One method of quite certainly lessening the amount of coming attack is by destroying the "flax-seeds" which are to be found (after threshing infested straw) in the siftings, and also sometimes in the light grain.

Where the screenings are merely of dust, rubbish, and weed-seeds, it would be little trouble or loss beyond cost of labour to have them burnt, or by any other more convenient way thoroughly destroyed;

* For further notes on straw imported from Russia see Appendix.

and where they are in the light grain, this should be cleared so as to prevent the "flax-seeds" being distributed with it.

In a letter from Mr. D. Taylor, of Daleally, on April 3rd, 1887, when this subject was under special consideration, he mentioned:—"We are boiling those 'flax-seeds' which are amongst the shag along with it, and feeding our horses and cows with it; the weeds and dirt are promptly destroyed." But in whatever way each owner may think fit to manage it, the matter of destruction of these "flax-seeds" is highly important, or in due season the insect-pest will be likely to hatch out and start new attack. Whether these chrysalids or "flax-seeds" have their vitality destroyed by being swallowed along with the light-grain food of the horses and cattle does not appear, but, judging by what happens in other cases, I should think it at least quite possible that being passed through the animal in the process of digestion did them no harm.

Prevention by ploughing in, or by burning infested stubble.

With regard to such amount of "flax-seeds" as may be left on the land, either on infested stubble or fallen therefrom to the ground, there does not appear to be any way of getting rid of these excepting by such ploughing as will bury them thoroughly down, or by burning the stubble.

In the case of deep ploughing, what is wanted is to skim off the infested surface and turn it over, and then bury this thoroughly down by another land-slice.

If the Hessian Fly chrysalis-case (that is, the "flax-seeds") are put (before the perfect fly within them has begun to form) in unnatural circumstances, it has been found, scientifically as well as shown in the previous observations, that the hatching-out of the fly may be delayed for many months,—indeed until the middle or end of the following summer. Therefore, if we bury the chrysalids well down, we may thoroughly expect to get rid of any present continuation of attack from flies out of these, and in all probability to get rid of them altogether. But if only common ploughing is done, and the edges of the land-slice left running in ribbons of stubble and weeds exposed to air and light, on the back of the previous one, then what "flax-seeds" may be there will be little injured, and will be likely to give out their pests in due season.

Whatever kind of plough, furnished with a skim-coulter, will effect the double work of first skimming and then burying the slice will answer the purpose.

Burning infested stubbles.

Where nothing further can be done it is at least desirable, directly after harvest, to skim infested stubbles and drag the rubbish

and burn it. Thus all of the pest that may be left will be destroyed ; and this year's experience has shown that the "flax-seeds" may be found *at the ground level*, and at the first knot, as well as at the second knot, and higher yet.

Where complete firing of the stubble can be safely done (and I saw, after last harvest, in many cases that this could be carried out) the plan is very desirable, and not only is destructive to the pest under consideration, but also destroys the maggot of the Corn Sawfly in the stumps of the stubble, which Sawfly maggot is, as far as I see, a greater evil to us than the Hessian Fly, and the attacks may very likely occur together.

But in burning stubble it is not right to let the fire go wildly as the wind may drive. The right way is to fire the field at the borders first. Thus there is only a slight warmth at first, and a line of fire quite under control near the hedges. The fire, as it spreads, draws towards the middle of the field, and, however the wind may drive, the flames cannot return over the already charred surface.*

Treatment of infested straw after threshing.

In regard to infested straw taken off the field, I am informed by Mr. John Martin, of Albion, Illinois, U.S.A., who has devoted much attention to the study of the Hessian Fly, that it is found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow ; thus a very great proportion of the flies which come out of the "flax-seeds" are destroyed, simply because they are not able to get to the outside of the stack.

Late sowing of autumn wheat.

This is a point that great stress is laid on in American practice, and it is especially recommended in the United States (where autumn Wheat-sowing runs earlier than with us) that Wheat should not be sown until after the 20th of September in the Northern States.†

In this country this remedy is applied for the most part in regular process of farming arrangements ; commonly our Wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

It is a quite plain thing that if, when the flies come out from the chrysalids, there is nothing suitable for them to lay their eggs on, that either the eggs will not be laid or the maggots from them will be starved to death ; and *I believe that it is very probably to this point of*

* For the above hints I am indebted to Professor Hoyes Panton, of the Agricultural College, Guelph, Canada.

† See Third Report of United States Entomological Commission, Department of Agriculture, p. 221, 1880—82.

Wheat-sowing being late that we owe being preserved from the portion of the attack to the Wheat as a young plant, which, I am informed by Prof. Riley, Entomologist to the United States, is one great part of the damage in that country.

It is bad enough to have attack bred out of the previous year's "flax-seeds" to the growing Wheat in summer, but, if we are spared the other half by late sowing in autumn, it should be urgently brought under notice of all concerned that they should scrupulously hold to this means of prevention, which can be carried out usually in regular course.

Many kinds of measures which possibly may be of use in lessening effects of attack of Hessian Fly require no comment in a Report of the past season's work, as no notes have been sent of anybody having tried them; but sound and trustworthy reports from practical agriculturists have shown that the amount of mischief caused by the pest is influenced by the state of the crop. It stands to reason, where loss is caused by straw elbowing down, that, if the straw is so strengthened by cultivation, or of such a firm strong nature that it does not give way under a moderate amount of injury, we must benefit.

From the comparatively small amount of damage done to our Wheats there seems reason to hope that, either from our climate or soil or the kinds of Wheat generally grown, this crop may not suffer as it does in other infested countries; and in the coming season the point of the kinds and condition of the Wheat and Barley crops which may best resist attack will be one of the points which it will be desirable to notice.

Amongst various places where supposed presence of Hessian Fly proved on investigation to be that of some other corn-pest, it may be well to mention that which was reported to be so severe on land at High Legh, Cheshire, that in the words of one published description the crop might have been carried away "in a wheelbarrow."

This being a matter of great interest, the field was examined by Mr. B. Kendrick, of Warrington, Hon. Curator for Entomology of the Warrington Museum, who favoured me with full details and specimens accompanying, by which it appeared the attack was not of Hessian Fly, but of the *Chlorops tæniopus*, the small fly of which the attack was so often taken for that of Hessian Fly during the past summer.

From the two figures now given for examination side by side it will be seen that these attacks (when once their appearance is known) may be very easily distinguished from each other.

Straw attacked by Hessian Fly maggots elbows sharply down (as we all know) above the attacked part, commonly above the second joint. The Hessian Fly maggot does not feed in the ear, nor does it feed along the outside of the upper part of the stem. This is what the *Chlorops*, or "Ribbon-footed Corn-fly," does.



H.K.—E.O.

FIG. 1.

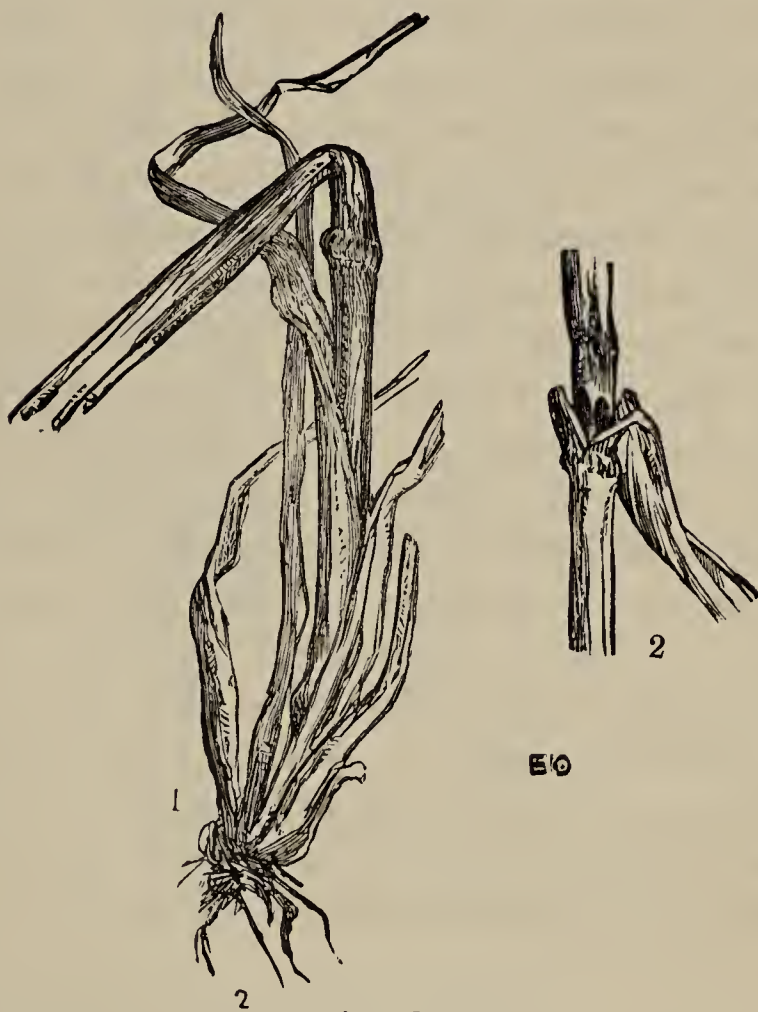


FIG. 2.

Fig. 1.—Barley ear and stem, showing *Chlorops* attack.

Fig. 2.—Barley stem, showing Hessian Fly attack. 1, bent down; 2, showing "flax-seeds."

The *Chlorops* is a small stumpy black and yellow two-winged fly, about the eighth of an inch in length; it lays its egg on the lowest part of the ears whilst the plant is still young, and, by the feeding of the maggot hatched therefrom, the lowest part of the ear is injured, and a blackened channel formed from the ear to the uppermost knot. This blackened groove runs down one side of the upper part of the attacked stem; but, besides this, the plant is often so stunted in growth and weakened that the ear is unable to leave the sheath.

Such an enormous quantity has been published from various sources regarding Hessian Fly attack during the last season that I have thought it best, in the above pages, merely to give the information which has been sent to myself in the senders' own words, so far as in me lay; and it will perhaps be most serviceable to present it just as it stands for readers to draw their own conclusions.

The two accompanying maps are merely added to give a general idea of the infested district. The localities which have been reported to myself, with specimens accompanying, and a few others which I have been informed of by competent observers, are distinguished by circles O or by groups of circles; the districts where the attack appeared in 1886-87 are marked by a black spot ● (of which one will be seen in England and three in Scotland); where present in 1886 only, by a square mark □; places where attack has been mentioned as present, but of which I have not personal knowledge, are marked by a cross ×; but, from the small size of the maps, the localities can only be generally indicated. From information received since the special reports were sent in, the East Riding of Yorkshire should be added to the infested district.

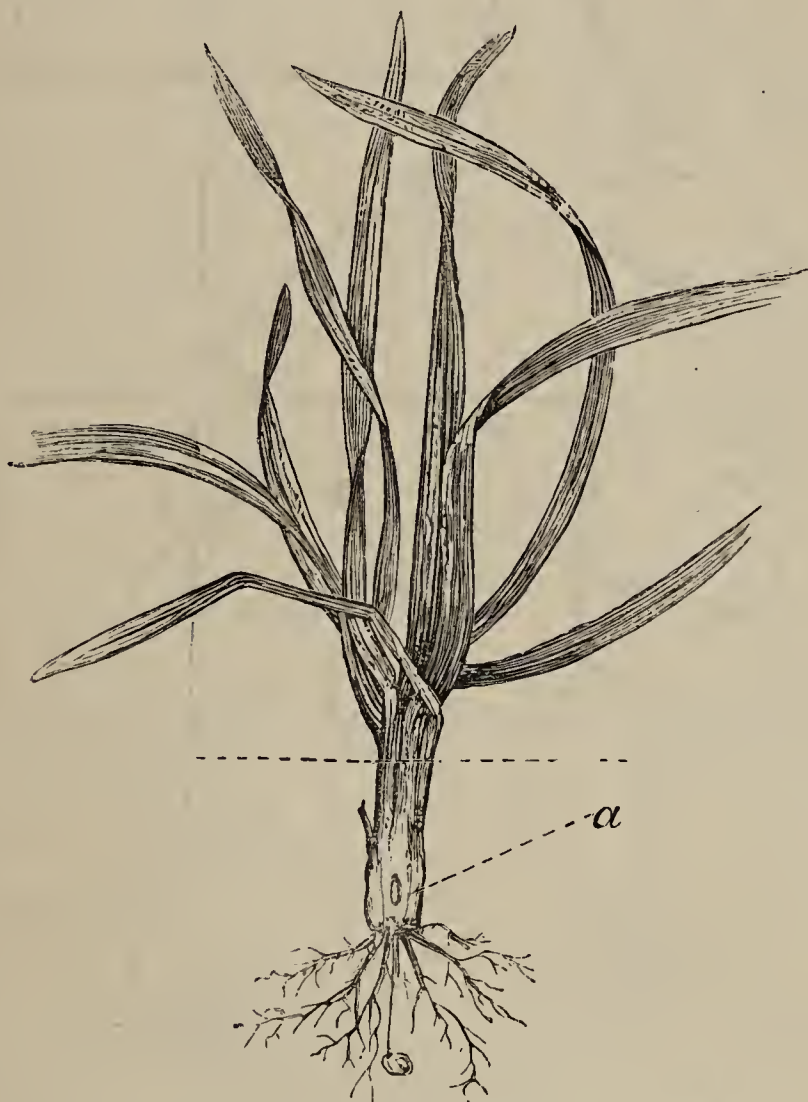
NOTE.—*Hessian Fly in young Wheat.*

At present we have no reason to suppose that we suffer at all from attack in the young Wheat-plant, but we cannot be too much on our guard. The following observations by some of the best known observers show the general points of the attack to the young plant:—

In the Report on Hessian Fly printed in Bulletin 4 of the United States Entomological Commission it is stated that “the worm in autumn lies at the sheathing base of the leaves just above the roots, at or near the surface. . . . The worms before assuming the flax-seed state rest between the leaves and the stalk,” and the suction of the sap by the maggots causes the plant to become unhealthy, and to turn yellow and die.

Dr. Lindeman also, in his work ‘The Hessian Fly in Russia,’ mentions that the maggot living in the axil of the leaf bores holes in the tender little stem of the young plant, and thus deprives it of sap; but he notes that the leaves of the attacked plant die off at one time, “commonly losing little of their green colour.”

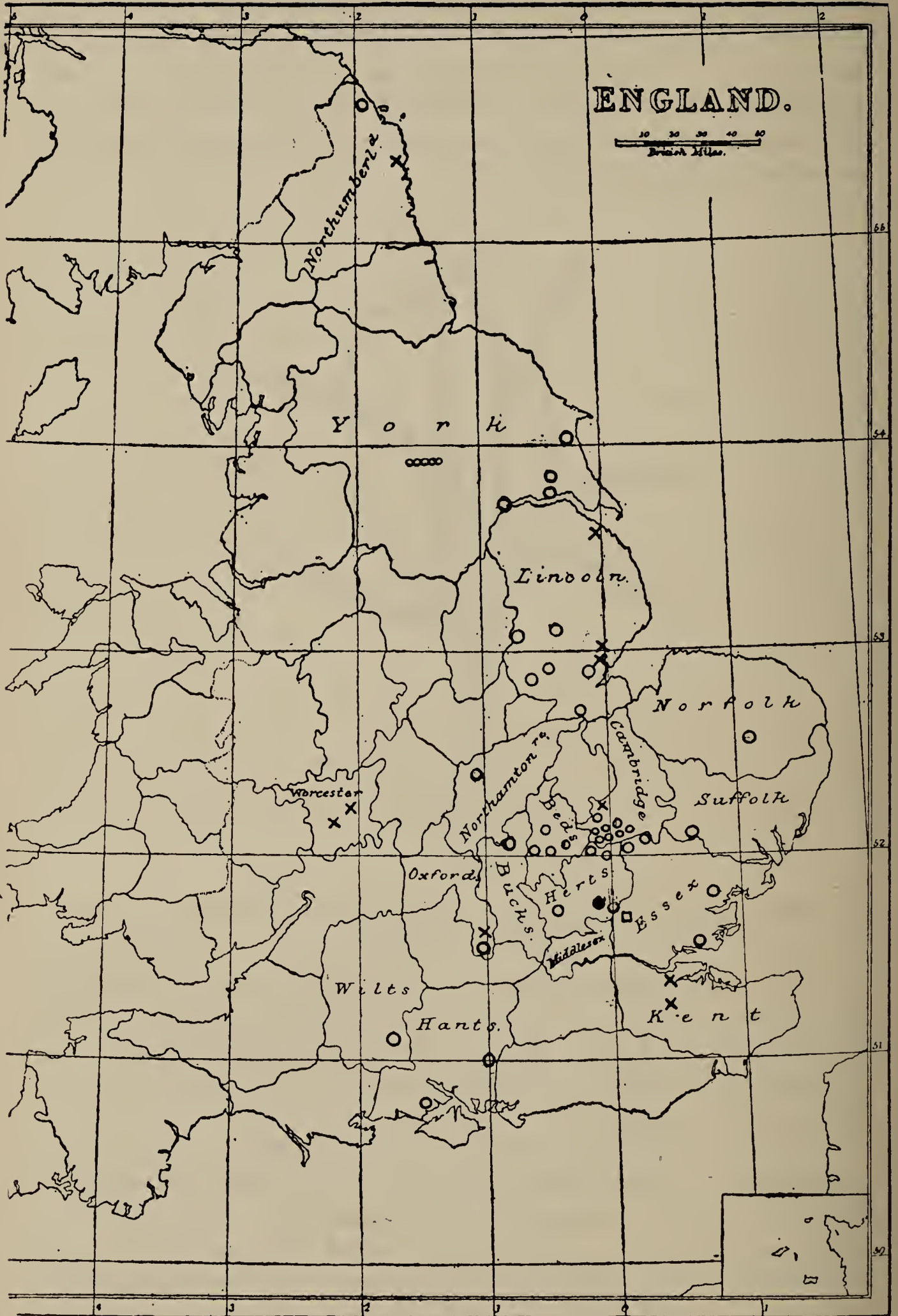
Prof. F. M. Webster, of Lafayette, Indiana, U.S.A., who has especially studied the subject of winter presence of the larva for the last three years, considers that it may be detected by peculiarities of the growth and colour of the infested plant. Whilst these pages were passing through the press, I was favoured by him with notes on the subject, of which I give below some parts (together with the accompanying figure), as follows:—



Plant of young Wheat, showing position of Hessian Fly maggot at “a.”
(After Prof. Webster.)

“The above figure represents a Wheat-plant affected by Hessian Fly, the flax-seed or pupa being shown at *a*, where the insect is now to be found, just under the sheath of the plant. If the insect has not advanced to this stage of development, they will be of the same form, but of a whitish colour.”

“The plant itself has not tillered, the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf, and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infested plant from one not injured. The yellow colour of some leaves is seldom observed, at this season of the year, on fly-infested plants.” — From circular by Prof. Webster on Hessian Fly maggot-attack to young Wheat.





The above notes all agree in what is the important point, namely, that the maggot is to be found under the sheath, or at the sheathing base, or axil of the leaves of the young plant; and I think it is to be gathered that change of colour to yellow or to dead green does not take place until the mischief is done. Further points are open to enquiry; any information as to presence on early-sown Wheat or Barley would be very useful, and I should be greatly obliged by specimens of suspected plants being forwarded to me.

Ribbon-footed Corn Fly. *Chlorops tæniopus*, Curtis.



CHLOROPS TÆNIOPUS.

2—6, Maggot, chrysalis, and fly of *Chlorops tæniopus*, nat. size and magnified. 7 and 8, *Cælinius niger*; 9 and 10, *Pteromalus micans* (parasite-flies), nat. size and magnified; 1 and 12, furrowed and infested corn-stem.

So far as may be judged by the reports sent in, the most destructive corn-stalk attack of last season was that of *Chlorops*, and the injury was certainly much more decided than that caused by Hessian Fly. This attack has long been known in this country, certainly as a crop-pest as far back as 1837.

So far as my opportunities for search have enabled me to tell, it is usually more or less present, and about eighteen years ago I myself shook the black and yellow fly in immense numbers from a stack in West Gloucestershire by simply thrusting my hand into the infested Barley-stack, and drawing out handfuls of straw and shaking them over a large sheet of paper.

This attack is demonstrably no new one, but it has been quite exceptionally severe in the last season, owing conjecturally to the exceptional heat and drought.

This "Ribbon-footed Corn Fly" is a small two-winged black and yellow fly, of the size figured above, and appearance as figured magnified. The injury is caused by the maggot hatched from the egg, deposited whilst the plant is yet tender, gnawing its way down from the ear to the first knot, often causing considerable damage to the lowest grains, and frequently so stunting the growth that the plant remains low and sickly, and without power for the ear to free itself from the sheath. But the special mark by which *Chlorops* attack may be known is the long, black, irregular furrow showing the track of the maggot outside the stem (see accompanying figure). The maggot changes to chrysalis on the plant beneath the sheathing leaf where it fed, and, as the fly soon emerges, it may sometimes be found in legions in fresh stacks of Barley.

On July 3rd Mr. J. G. Mann, writing from The Grange, Bishop's Stortford, Herts, mentioned:—" *Chlorops tæniopus* swarms in my late Barley, and also in my neighbour's. I also went into North Essex and South Cambs. last week, and found it there in all the late Barley . . . this has done much harm. Also on the above day (July 23rd) specimens of Barley-ears attacked by *Chlorops* were sent me by Mr. Richard Fowler from Broughton, near Aylesbury, Bucks, with a note that the crop was very much broken."

A communication was sent to me on July 21st, from Wilstead, Bedford, by Mr. James Newman. He mentioned:—"I have enclosed in the box some ears of Barley, in which you will find an insect eating the stem, and also up to the ear and stopping its growth; and six more in the small paper parcel, taken out of other ears. I find a great many more in late-sown Barley than in early-sown. . . . I was over a large field of Barley yesterday, thirty acres or more, and more than half had stopped growing by this insect."

On July 26th a parcel of Barley was forwarded by Mr. Towse, of The Avenue, Streatham, showing attack



Stem of Barley attacked by *Chlorops*, showing blackened maggot-channel.

of the *C. tæniopus*, but which had been attributed to that of the Hessian Fly. Mr. Towse mentioned that he had visited several farms in Essex and Hertfordshire, where he had found the Barley attacked in every direction. He is of opinion that the pest is more to be feared than the Hessian Fly.

During August many enquiries were sent in, with specimens accompanying. On the 3rd a sample of attacked Barley was sent me from Heyford Hills, Weedon, by Mr. John A. Hardy. On the 9th a sample from Gowan Mains, Girvan, N.B., was sent by Mr. J. M. Hannah, with a note that the attack was "very materially lessening the chance of a crop." On the 11th similarly attacked Barley was forwarded by Mr. C. Manners Norman from Peckleton Manor, Hinckley; and on or about the 12th I received specimens of Barley, injured by this same *Chlorops* attack, from the Park Farm Office, Woburn, Beds, sent by Mr. J. B. Woodforde.

On Aug. 13th three applications were sent, with specimens accompanying; one from Mr. C. Magniac, of Colworth, Bedford, as showing "a pest—new to us—which is doing great damage to the Barley." "The grub seems to eat downwards to a joint"; a parcel of Barley was also sent from Little Welnetham Hall, Bury St. Edmunds, showing attack of the same kind, with the brown chrysalids also accompanying. About four acres in the middle of a seven-acre field were stated to be like the sample sent, the remaining three acres being sound and good; and on the same day a note was sent me by Mr. Francis E. Frazer, with specimens of *Chlorops*-injured Barley, from the Experimental Farm, Woburn. Mr. Frazer mentioned that the Barley was attacked by an insect which was doing considerable damage; "the infested plants do not come out in ear properly, as they never leave the sheath."

On Aug. 16th two parcels of straw, both of which proved to be injured by *Chlorops tæniopus*, were sent from the Bedford Estate Office, Bedford, by Mr. Herbert Fenning; and on the 19th chrysalids corresponding with those of the *Chlorops* were forwarded by Mr. Joseph Martin, of Highfield House, Littleport, near Ely, from a Barley-field on one of his farms in the parish of Hilgay, Norfolk. On the 19th Mr. Ardron, Secretary of the Leicestershire Agricultural Society, Syston, Leicester, forwarded heads of Barley attacked by the same insect.

On Aug. 22nd Mr. C. J. Maxwell Lefroy forwarded a sample of Barley from Crondal, Hants, similarly attacked, with a note that much damage had been caused to a large field of Barley. "The soil is light loam or chalk; prior crops, Sainfoin for five years, then Oats; land 'steamed,' and 4 cwt. artificial manure to the acre."

On the 24th specimens of *Chlorops*-injured Barley were forwarded by Mr. James Carter from Burton House, Masham, with a note that

the farmer who sent them had about 500 acres of grain crops, and a great deal of his Barley appears to be affected. On Aug. 29th specimens of the same attack were sent me on Barley-stems from the Estate Offices, Ashby-de-la-Zouch, by Mr. John Gorman, with an observation of the damage being noticeable at the highest joint beneath the ear, and also that a husk or skin (that is, the chrysalis-case) was left behind in each stalk. The small brown chrysalids, or chrysalis-cases, are very often to be found lying in the blackened channel (see fig.). They are distinguishable by their cylindrical shape from the Hessian Fly chrysalids.

Specimens of quite unusually bad attack of *Chlorops taniopus* were sent me on Aug. 30th from Bettinge, Herne Bay, by Mr. W. S. Solomon. The ears were mostly still in their sheaths, and the stems were short, some seven to nine inches high, one only about six inches in height. This Barley was grown after Wheat which had been entirely destroyed by "the maggot" in the spring. The observer remarked that he had first seen Barley affected in this way four or five years ago. Chrysalids and cases taken from the straw were sent with the specimens.

On the 30th of the month ears of Barley taken from a field one mile from Pocklington, York, were sent me by Mr. T. Browne (Market Place, Pocklington, York), in which the heads of the Barley were out of their sheaths, but the black channels showing where the *Chlorops* grubs had fed were remarkably observable. These may always be looked on as a sign of this attack.

On Aug. 8th Mr. Geo. Cook forwarded specimens of *Chlorops*-injury to Barley from Kitwick Wood, Ampthill, with the remark that this attack appeared more destructive than that of the Hessian Fly. He noted:—"You will observe that it appears to eat away part of the stalk near to the ear, and in several cases I noticed it had eaten the unripe kernels of the grain itself. It appears to attack the later-sown crops the most, as I do not discover it in the first-sown Barley of my friend or my own. The crop in the usual four-course rotation; the previous crop, Swedes eaten off with sheep, and the crop before Swedes was Wheat."

On Aug. 28th the following note of *Chlorops* attack and estimate of damage was sent me by Mr. Riley from Hessle, near Hull:—

"I sent you yesterday some stalks of Barley reported to me by two or three farmers as badly infested with "Hessian Fly." I therefore drove over on Friday to see the field, and found that it was not 'Hessian Fly,' as it had begun *from the ear and worked down to the first joint*, and found it had done *ten times* the amount of damage done by the 'Hessian Fly.' I and two other very practical farmers thought the crop was damaged *fully one-third*. I have not yet seen a field damaged more than one *bushel* an acre, simply because the attack came *late*. The

Barley (specimens sent) was sown *late*; the previous crop *Turnip*, and *very good*; one or two other late pieces of Barley are so infested."

On Aug. 5th specimens of a remarkably bad attack of *Chlorops tæniopus* were forwarded to me from Barley at Ropley, near Alresford, Hants, by Mr. J. W. Snelling, Winchester. The ear in some instances was hardly freed from the sheath, and the stem above the highest knot was only from about $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long. The ears were stunted and injured, and the direct injury from the maggot gnawing usually affecting the lowest part of the ear, or as much as halfway up.

From the above returns it appears that the attack was present in Hampshire and Kent; in Essex, Herts, Beds., Cambridgeshire, Leicestershire, and on the border of Leicester and Warwickshire; also in Northamptonshire and in Yorkshire; and it was also present in Cheshire. Only one note was sent me of presence in Scotland, and this was in Ayrshire.

The specimens sent me showed various degrees of injury; as the growth being stopped at six to nine inches high; the ear still muffled in the sheath; the uppermost joint of the stem stunted to about two inches in length, the base of the ear and sometimes half of the lower part being destroyed by the maggot; and (constantly) the gnawed and blackened channel where the *Chlorops* maggot had eaten its way down from the ear to the uppermost knot was clearly noticeable.

Looking at the remarks as to amount of injury sent in by observers, the highest estimates were of more than half stopped in growth, and of one-third of the attacked Barley; also it was noted as doing great damage to Barley,—materially lessening the chance of a crop,—and as appearing more destructive than Hessian Fly.

This is a kind of attack in which it would be very useful if the sufferers from it would give particulars of the nature of the land on which it occurred, most especially whether it was found in patches in the fields, and whether these patches, large or small, were lower-lying than the rest of the land. Where I have most observed this attack in former years such has been the case. I have seen it on an acre or more forming a kind of hollow; also near Isleworth in a low-lying portion of a field which had not been properly drained when thrown into cultivation after the surface-layer of brick-earth had been removed. It is also said to occur along water-furrows, and in the very bad case of *Chlorops* attack which occurred last year at High Legh, Cheshire, the part of the field from which specimens were sent me was reported as low-lying and damp. This attack deserves special mention.

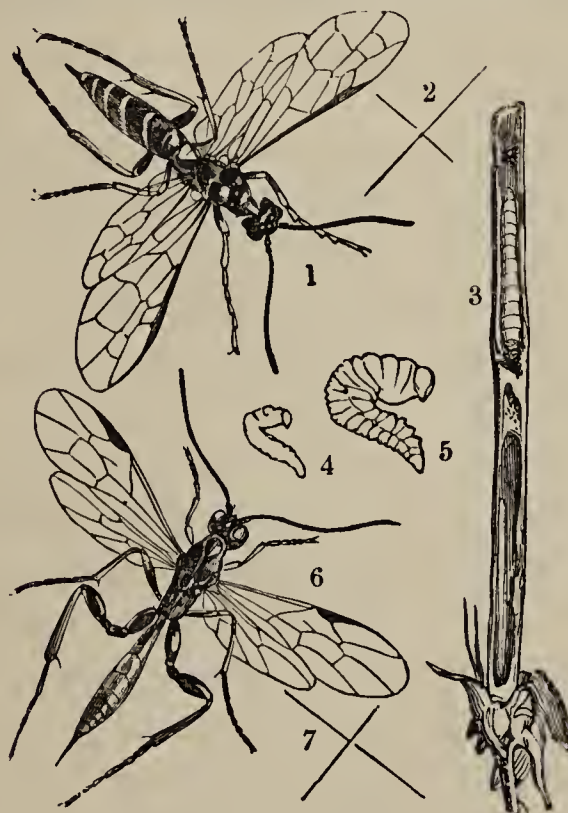
On Oct. 8th I was favoured by a communication from Mr. B. Kendrick, 33, Golborne Street, Warrington (Hon. Curator for Entomology, &c., of the Warrington Museum), relatively to severe damage to Barley at High Legh, Cheshire, which had been erroneously attributed to Hessian Fly.

Mr. Kendrick visited the spot, and forwarded me samples of the Barley which were infested, not by Hessian Fly but by *Chlorops*, and badly injured; and accompanying these he sent a report that he could not find any stems bent from insect injury, but found stunted Barley-ears, which had not been able to emerge from their sheaths; and on referring Mr. Kendrick to the description of *Chlorops* attack and the figure given at the head of this paper, he stated there could be no doubt of the identity.

This account and identification is of importance, as temporarily much alarm was raised regarding the supposed Hessian Fly attack; but, further, it is of interest relatively (as I noticed just above) to the low and damp situation of the examined Barley. This was stated to be a "good-sized patch in the lowest and apparently rather swampy part of the field"; also the ground "was much overgrown with *Persicarias*," a weed which it is unnecessary to say thrives in moist places.

If this attack especially affects damp spots, or spots which have been wet and then surface-baked, one method of prevention would be obvious; but, as in all the many years in which I have known it this attack has never before been serious, I attribute its severity last year to the unusual heat and drought, and should not conjecture that a recurrence was to be expected.

Corn Sawfly. *Cephus pygmæus*, Curtis.



CEPHUS PYGMÆUS.

1, 2, Sawfly, magnified, with nat. size; 3, stem containing maggot; 4, 5, maggot, mag. and nat. size; 6, 7, parasite fly, *Pachymerus calcitrator*, mag., with nat. size.

The presence of Corn Sawfly, like that of *Chlorops* was much more observed than is usually the case in England last year, and the notes

I received showed it to be at least scattered over a wide area. Note were sent with specimens accompanying, showing it to be present in one or more localities in Essex; near Long Melford, Suffolk; in Cambs., Beds., Hunts, Lincolnshire, and Northamptonshire; also in Berks, Oxfordshire, near Reading, and in Hampshire; but I had no observations sent of it being noticed in the North of England, or in Scotland.

It will be observed that these localities correspond very much with those of *Chlorops* and with the districts where the Hessian Fly was most prevalent in England, but whether this circumstance arises from the attack chiefly existing in this area, or from attention being more drawn to the subject of corn-stalk pests in these localities, I am unable to say.

The method of life of the Sawfly grub is to feed *within* the corn-stem, clearing the inside of the knots in its passage, and about harvest-time it comes down to ground level, where it gnaws a ring so neatly and cleanly round inside the stem that the straw readily falls with its own weight, or from slight pressure of the wind, the severed stalk showing almost as smooth a fracture as if it had been separated by a knife. As, both in this case and in bad injury from Hessian Fly, the straw falls, the two attacks are very liable to be confused in mere casual examination; but when looked at with care it will be readily seen that in this Sawfly attack the straw is cut through (fairly separated) at ground level, and in Hessian Fly injury the stalk is *not* cut through, but elbows sharply down commonly at the second joint from the ground, and consequently on the weaknesses caused by the maggots *sucking outside* the stem at the spot where they turn to the flat flax-seed-like chrysalids.

The Corn Sawfly has long been known in this country as a crop-pest, and also on the Continent of Europe, but, as far as I have been able to learn by investigation or enquiry, it is not a crop-pest of America; and as I have pointed out elsewhere, this is not one of the attacks which can be conveyed in grain, chaff, or straw. The maggot itself cuts the corn-stalk below where the cutters of the reaper separate the stems and it remains, not in the upper part, which is carried away, but down in the stump which remains in the ground. There it spins itself a thin cocoon for its winter protection, and there it remains until the early summer of the following year, when the four-winged black-and-yellow fly (see fig. p. 59) comes out of the chrysalis to which the maggot had turned in the straw.

As the maggot remains down the stump left in the ground, it is not liable to be removed in the reaped straw, and any method which may be preferred of destroying the infested stubble will get rid of danger of recurrence of attack from that of the preceding year.

Ploughing would not do this securely unless the stubble was thoroughly well buried down; if only partly buried the maggots

would probably be no way injured. If it could be completely buried down and left there this would answer; but I believe the most sure plan is after harrowing, &c., to collect the stubble in heaps and burn it.

The first *signs* of the coming of the attack of the Corn Sawfly which proved so noticeable last year were reported to me by Mr. Thomas P. Brand, of Brook Hall, Foxearth, Long Melford, on the 28th of June; this is worth remarking, for it is very seldom indeed that it happens that in crop-attacks of this kind we have information of the appearance of the insect, be it fly or otherwise, which will give rise to the mischief, before the crop has shown that the havoc has been established.

Mr. Brand wrote me on June 28th:—

“I have sent you two flies which I caught off my Wheat last evening, and saw a great quantity more of them.”

Of these specimens one was still alive, and was excellently characteristic of the appearance of this kind of Corn Sawfly, as described at length further on.

On the 20th of July Mr. Whitehead informed me that he had a lot of straw (Barley) sent from Huntingdon, with *Cephus pygmæus* maggots in every stem.

July 26th. Mr. W. Rance wrote me from Taplow, Maidenhead, that he had six acres of spring Wheat, which had a very bad appearance, and on examination he found it affected by a grub in the stem close down to the root,—specimens accompanying showed this to be the Corn Sawfly maggot.

On the 28th of July Mr. William Hall forwarded me a parcel of Wheat roots and stems, containing a grub close to the ground, from Redbourne, Kirton Lindsey (Lincolnshire), with the observation that he had been much struck by a quantity of his Wheat appearing as if it was what is called storm-broken, and on examination he found in all cases that there was a grub, either close to the ground or a little way up the stem.

The samples forwarded proved to be remarkably characteristic specimens of Corn Sawfly attack; the Sawfly maggot was down quite at the bottom within the stem, and the crisp, clean breaking off of the stem at the ring which the maggot had bitten within was very noticeable.

On the 1st of Aug. Mr. W. Hall further mentioned that the Sawfly attack had quite damaged the yield of the Wheat in that parish (Kirton Lindsey) from a sack to a quarter of an acre.

On July 30th Messrs. Sutton and Son, of Reading, consulted me regarding attack to a large quantity of Wheat on a farm in the neighbourhood of Reading, which on examination of specimens proved also to be injured by *Cephus pygmæus*; and on the same day Messrs. Oakshott and Millard likewise desired an opinion on “stems of Wheat

attacked by some minute maggot inside the pipe, which causes the ear to go off prematurely"; this attack on examination proved to be that of the above-named pest.

Somewhat later on Messrs. Oakshott remarked, of this corn-pest, that it appeared to them "from what we have seen of further specimens brought us to-day, to be likely to be even more serious than the Hessian Fly.

Some of the above information was given by Mr. E. Whitfield, of Goring Heath, near Reading, who after an interview with me, further reported on the 9th of August:—"Since I saw you last Thursday I have examined several more pieces of corn in my neighbourhood and find the same pest in them all more or less (excepting in Oats). I yesterday searched through a field of Barley and Oats mixed; I could find the maggot in the Barley but not in the Oats, so that I feel satisfied it does not attack Oats. One thing I have remarked particularly in my Barley, that is, on the parts of the field where the best Turnips were and more corn fed by sheep, there is more ravage by the fly, although it was all drilled the same day and treated in the same way exactly. Do you think the very long dry hot season is the cause of the extensive ravages of this fly? This part of Oxon lies high, and the land is as a rule light poor soil, and feels drought severely. We have had only two showers since the 3rd of June."

Mr. Whitfield's report regarding previous treatment of the land where the Wheat was injured, showed similar amount of attack after Clover; and also "where the Clover being thin had been ploughed up after the hay was gathered and Mustard sown. This, together with the aftermath, was fed off by sheep. A good fair coating of manure was applied and the Wheat sown in October"; and on another Wheat-field on a better soil, after a summer fallow, and a fair coating of manure, and seed sown in November, the attack was about the same in amount.

In the case of another field of Barley which was after Wheat (the latter a very bad crop), Mr. Whitfield observed that he did not notice that the fly was in the Wheat in the preceding year, but the amount of attack in the year's Barley was about the same as in the other fields. All the fields were quite separate from each other on different parts of the farm.

With regard to amount of damage, it was mentioned by Mr. Whitfield:—"Some of the ears appear to be full and not much the worse, whilst others have only thin corns in them; the straw being laid down, much damage arises from the machine cutting the ears off; the straw also would be rendered unsaleable for plaiting purposes, being filled as it is with dust."

The prevalence of this crop-pest near Birchmoor, Woburn, Beds., was reported on Aug. 3rd by Mr. Edward Blundell, who remarked

(comparing the relative amount of this and of Hessian Fly):—"So far as I have at present seen *Cephus pygmæus* is much the most busy with us, for I can find it in great abundance in nearly every Wheat-field in the district.

On August 6th I had examples of attack of the same corn-pest sent me by Mr. R. Lesson Martin from Helpston Village, Market Deeping, out a crop of Wheat then being cut; and also on Aug. 6th, a specimen of *Cephus pygmæus* attack with the maggot in the straw, was sent me by Mr. F. Scorer, from Swinhope, Great Grimsby, accompanying samples of Hessian Fly attack.

On the 9th of August specimens of straw were sent by Mr. Stephenson, from Burwell, near Cambridge, showing the straw partly filled with the sawdust-like excrementitious matter consequent on the Sawfly maggot feeding within the stalk; and on the 15th Messrs. J. Robinson and Son, of Northall, Kettering, forwarded samples of the same attack, with the observation that neighbours had applied to them in great trouble on this account.

The following notes from Mr. D. D. Gibb, of Thorn's Farm, Lymington, gives a somewhat more detailed account of the appearance of the attack. On the 17th of August he noted that at harvest-time he had found in the Wheat what he believed to be the Corn Sawfly (*Cephus pygmæus*), "had been busy at work; the larva had cut the straw at ground-level, the stalks falling down presented a very pinched appearance,—in some cases worthless. To-day, on inspecting some late-sown Barley, I found the Sawfly had again showed itself there in great numbers."

Mr. E. M. Edwards, writing on the 24th of August, from the Precincts, Peterborough, forwarded straws showing the depredations of the Sawfly maggots, and in some cases the insects then present, from a portion of a Wheatfield in the neighbourhood, which was much destroyed by the grubs.

On Aug. 22nd specimens of Sawfly attack were sent me from near Spalding, Lincolnshire; and on Sept. 5th Mr. J. A. Smith, of Akenham, Ipswich, wrote that in looking *ineffectually* for the Hessian Fly on his own farm, he had for the first time become aware of the great damage inflicted on the crops by Corn Sawfly.

There does not appear to be any reason to fear recurrence of attack from infestations of one year keeping up supply to the next, in places where the maggot has been destroyed in the stubble, as mentioned at p. 60; but as attention has been directed to this subject, it would be of serviceable interest to know whether in the coming season the corn-pest is again very noticeable, and also to have estimates of the damage caused by it. I should be greatly obliged if my correspondents would give me details regarding this attack, if it should occur, or also that of *Chlorops*, which is previously noticed.

**“Tulip-root” Disease from Eelworm, *Tylenchus devastatrix*,
Kuhn.**



TULIP-ROOTED OAT PLANT.

The disease known as “Tulip-root” in Oats takes its name from the swollen appearance of the base of the stem, which bears some resemblance to a Tulip-bulb, though still more to a “duck-necked” Onion. This swelled stem is usually surrounded by a number of small doubled-up shoots, pale in colour, and bent to and fro instead of being properly extended. The above figure shows the appearance of an attacked plant as it is often seen; the disease is also known as “Segging,” or “Sedging,” from the Sedge-like appearance often assumed by the leaves. From the healthy growth of the plant being checked there is necessarily much loss both in straw and grain.

This disease has been much noticed of late years, especially in Scotland; and on investigation in 1886, I found Eelworms present in the bulb-like base of the stems, as well as in the spongy curled shoots; and from the resemblance of the diseased Oat-plants to the diseased appearance which is assumed by Rye when attacked by the Eelworm known by the name of *Tylenchus devastatrix*, it appeared likely that this Eelworm was also the cause of our attack, and on special examination being made by Dr. J. G. de Man and Dr. Ritzema Bos (already referred to in this report relatively to their studies of this subject) such proved to be the case.

During the spring of 1887 I was favoured by Dr. Ritzema Bos (for the sake of parallel examination) with specimens of young Rye-plants, of about three to five inches high, suffering from the “stem-sickness,” as this attack, answering to our “Tulip-root” in Oats caused by the Eelworm above mentioned, is called in Germany. These plants showed precisely the same nature of deformed growth as our own Tulip-rooted Oats; the lower part of the stem was similarly

swollen, and round the base (similarly also to our Eelworm-diseased Oat-plants) there were sometimes short, pale, abortive shoots, wrinkled or folded to or fro on themselves. Within the swollen bulb the Nematodes or Eelworms were very plainly to be seen, and with a 1-9th object-glass I could easily distinguish the smooth spear and its lobed base.*

These Eelworms, that is the kind known as *Tylenchus devastatrix* (which is much smaller than the species figured), infest many kinds of plants, but as far as we know at present do not infest Peas or Beans; and it is of very practical importance relatively, to change of crop on infested land, to know what is safe from its attacks. The following observations refer to examination of Beans and of Wheat.

In 1886, as there were doubts as to Beans being infested, I examined specimens, but could not find an infestation present.

In 1887, Mr. R. Drennan, writing from Goatfoot Farm, Galston, Ayrshire, forwarded me, on the 18th of May, samples of Beans and Oat-plants, from a locality which had suffered seriously with Tulip-root “for a number of years”; he also forwarded me a sample of Wheat from other land which had been badly attacked by Tulip-root when it had been cropped with Oats.

On examination, Dr. R. Bos found *Tylenchus* in the Oats, but *none* in the Beans, and *none* in the Wheat; and relatively to possible presence of this pest in Wheat, he mentioned that during four years’ experiments with Wheat sown by him on land infested by *T. devastatrix* from Rye (the same which infests our Tulip-rooted Oats), the Wheat “never became diseased in a clear and pronounced manner.”

* The accompanying figure of the kind of *Tylenchus*, the *T. tritici*, which causes ear-cockle galls in Wheat, is added to give a general idea of the shape of the *T. devastatrix* which causes Tulip-root in Oats.



TYLENCHUS TRITICI.

Wormlets escaping from eggs; section of Cockle-gall with wormlets within (after Bauer’s figs.), *T. tritici*, all much magnified. Spikelet of Wheat with Cockle-galls, magnified. Nat. length of wormlet one-seventh to one-fourth inch.

It had been stated by previous observers of the subject, that this special kind of Eelworm never lives in Wheat; but Dr. R. Bos found it was present in the Wheat above mentioned, though never in large numbers; and he considered that *Tylenchus devastatrix* can live in Wheat-plants, but *does not* do so, *unless* there are no other plants on the land which it likes better."

The first specimens of Tulip-rooted Oats which I received in 1887 were sent me on the 30th of May, by Mr. Thos. Picken, of the Field-house Farm, near Brentwood, and, from the notes sent accompanying, it appears that the portion of the Oat-crop from which these samples were sent (*which was not dunged*) was the only part of his Oats which was affected.

Mr. Picken wrote:—"We commenced sowing Oats on the 29th of March (seed from the Lincolnshire Fens); the *first* day's sowing was after a heavy crop of Mangold, which are doing exceptionally well. *Second* day's sowing after a poor crop of Tares on foul land, which also looks well. *Third* day's sowing after clean fallow, some of which was dunged and looks well, and some (*about half*) *has gone off in the way of the enclosed.*" These Oats were thoroughly characteristic specimens of Tulip-root. Some sent a few days later were still more diseased, being little more than small masses of crinkled-up yellow shoots; the greatest height of the healthy leaves on the others only ranged up to about three or four inches.

On examination of these plants Dr. de Man favoured me with the information that he had found in the interior of the basal part of the stem *a large quantity of living* specimens of *T. devastatrix*, and a few days later Dr. de Man added that he had examined more of the plants, and had observed in all of them large quantities of living specimens of *T. devastatrix*.

Dr. Ritzema Bos also considered the above to be very characteristic specimens of the peculiar diseased growth under consideration, and on examination he found in them "a large number of *Tylenchus devastatrix* males and females, larvæ and eggs."

Specimens of Oats in a very early stage of attack were sent me on the 8th of June, by Mr. Richard Brown, from Hill House, Kirk Newton, Midlothian. The plants were somewhat swollen at the base, but as yet only one plant had advanced to having the characteristic small pale crinkled shoots; on opening them I found Eelworm of various sizes within, and the egg was present also.

Mr. Richard Brown mentioned that the specimens had been pulled "at the earliest moment we have been able to discover any appearance of the disease. These grew on a field worked on the four-course shift, which was Hay last year, and before ploughing the lea got a good

application of gas-lime. The land is in fair condition, but it is also liable to ‘Finger-and-Toe.’ ”

On the 9th of June specimens of badly Tulip-rooted Oats, in which I found Eelworms, were sent me from Hogmore Farm, Wrotham, by Mr. W. J. Goodwin, with a note that they were from a twenty-acre field, and that he “did not expect to grow more than two or three quarters per acre”; also that “the same disease had been known before in the same field, but not such a bad attack”; and that he heard many fields in the neighbourhood were struck in the same way.

Specimens of Tulip-rooted Oats having the bulb swollen, but much of the deformed side-growth of little shoots then developed, were sent me on the 20th of June, from Peterhead, Aberdeenshire, by Mr. J. C. Greig. The Eelworms were clearly noticeable within. Mr. Greig observed first, relatively to the various names by which this attack is known:—“It goes here by the name of ‘Sedging’ (locally ‘Segging’), from the fact of it growing only a bunch of Sedge-like leaves but never forms a grain, and by harvest, when the leaves are down, where badly “segged” the crop is almost *nil*.” [This of course refers to the worst form of attack.—ED.] “So far as I am aware it seems to be confined within a small radius here, and always on strong land.”

Somewhat later, that is on the 6th of July, Mr. Greig wrote me further regarding the Tulip-root attack or “segging” of Oats, that it usually showed itself there in a special part of the rotation. He remarked, “The land here (at least on all strong soils liable to (“segging”), is worked on what is called a seven-course shift, that is, two white crops, Turnips, white crop again, and three grasses. It (“segging”) usually shows itself on second year’s corn and after Turnips; a crop of Barley after Turnips seems to stop it for that time. This year, however, it has shown itself mostly on corn after lea.” . . .

The following observation shows recurrence of Tulip-root attack to Oats sown on land infested in the previous year:—

On the 12th of July I received a sample of Tulip-rooted Oats infested by Eelworms, with their eggs also noticeable, from Mr. Holland, the Consulting Botanist of the Royal Manchester, Liverpool, and North Lancashire Agricultural Society (Frodsham, Warrington). These Oats were grown on the Experimental Ground of the Society at Saltney, and Mr. Holland remarked, “Last year we had Oats on the same plot, and they were almost entirely destroyed by the disease, and we supposed it to be caused, or at any rate aggravated, by the very wet season. We sowed Oats again to see if it would again appear, which it has done, although the Oats are a different variety (and therefore the seed has nothing to do with it), and though this season is as dry as last season was wet, showing that weather does not affect it.”

On the 19th of July Mr. Robert Holland further mentioned that, though he had grown Oats for thirty years at least, and been in the habit of observing, yet he could not positively say he had seen Tulip-root until the previous year. He further remarked, "The plants I sent you were grown in Flintshire, though only four miles from Chester, but the disease was also observed in Cheshire, at Mr. John Lea's of Stapleford Hall, not far from Tarporley. . . . The field from which my specimens were obtained was in Wheat in 1885. The Wheat was succeeded by Oats in 1886, and, as I mentioned, they were destroyed by the disease. They were sown on the same ground again this year, partly with a view of ascertaining whether they would again be affected. They are so, though hardly to so great an extent. That the Oats, this year, were attacked by the parasites which remained in the ground, or in the stubble, from last year's crop, one can scarcely doubt; but then, how did last year's Oats become diseased? I think, but I am not sure, that the Wheat was grown on Clover ley; but we are not subject to Clover-sickness in this part of the country."

In this case (as in many others) we cannot tell for sure how the attack came, but still Mr. Holland's note shows that the land has been four years under plants subject to Eelworm, so that a change to a crop not liable to infestation is now important.

On August 30th I was favoured with the following report by Mr. Robert Dundas, of Arniston, Gorebridge, Mid Lothian, N.B. In the previous year Mr. Dundas had contributed some notes of much interest on the subject, together with a map of fields attacked at Arniston Mains, which I have given at page 42 of my 10th Report, and the information now added is very serviceable, both as showing that attack is not necessarily continued from one year to the next; consequently it would help very much in badly infested districts, if we could have notes of treatment which has been used in these cases where attack has *not* continued, and also in cases where attack *has* continued.

Mr. Dundas mentioned, . . . "In 1885 a field of Oats was badly affected with the disease, but during the past two years nothing has been observed wrong with the pasture. In 1886 another field of Oats was badly affected by the disease, one spot in particular, of about four acres in extent, being quite destroyed. This year, on that place, no sign appears of anything being amiss with the Clover, which is a good crop.

"In 1887 a third field of Oats has been affected by Tulip-root, from which the enclosed bundle has been taken. But instead of great spots over several acres this year, the spots in the field affected are few in number, and only of a few yards in extent. In fact, if I had not

been on the look-out, this year's spots would have been scarcely noticed, or, if noticed, ascribed to rabbits.”

At present very little information has been sent in (excepting one note in the preceding observation) as to effect of farm manure in pushing the plant past attack, but the following observations of Mr. Elder, of The Holmes, Uphall, Linlithgowshire, point to the disease being worst on gravelly elevations, and also mention the good effects of sulphate of potash, and the *non-effect* of nitrate of soda in the case of a field experimented on and described in the observations as field “No. 2.”

The experiments were made in 1886, and alluded to at p. 40 of my Report for that year, and on the 30th of March, 1887, I was favoured by Mr. John Elder with a more detailed account of his experiment.

Mr. Elder remarked, “My farm is mostly free alluvial soil, with some gentle knolls of sand or gravel. These knolls were worst affected with Tulip-root, the more retentive soil immediately surrounding them being entirely free and a very heavy crop. A portion of one field which was heavy loamy soil, was more or less affected, but in this case the drainage was bad, and the land soured.

“What I have written refers to Oat crop after Potatoes and Turnips, manured with horse and cow dung, and receiving no special treatment.”

So far the notes show occurrence of the disease where there was some special state of ground which would influence the growth of the plant, as the soured land or the raised sandy knolls; the following observations refer to action of the chemical dressings. Mr. Elder continued—

“Other two fields were Oats after Hay, after Barley, after Turnips, Beans, and Potatoes. No. 1 received when sown (in addition to an allowance of bones), about 28 lbs. of sulphate of potash, and the same of sulphate of ammonia. A good sound crop was the result, no Tulip-root being observable *except on a gravelly knoll*, and even then to a small extent.”

The second of the fields was reported at length as follows:—

“No. 2 received superphosphate and sulphate of ammonia, but no sulphate of potash when sown, except the head-rigs, which received at the rate of three-quarter cwt. per acre in addition to superphosphate and ammonia, when I sowed Vetches and Oats in equal proportions. The effect of the potash was most extraordinary, and where I ran short before coming to the end of the field there the effect ceased,—what received the potash grew on most luxuriantly, while the whole of the field (with that exception) threatened to be a complete failure.

“I then gave 1 cwt. of nitrate of soda per acre (to field No. 2), . . . but this, after a fortnight of growing weather, was making no improvement. I then procured sulphate of potash and applied half

cwt. or so per acre; a nice shower washed it in at once, and a fortnight after no one would have known it to be the same field, and I harvested a very heavy crop from it."

As far as I can gather from the observations of 1886 and '87, and also from Continental practice, a good growth on properly cultivated land, neither too dry on knolls nor soured by being undrained, and also a liberal supply of rich manure, help greatly to bring the crop through or prevent attack. But where stock have been fed on straw or Clover which has suffered from Eelworm attack, it is absolutely necessary that the manure made from infested fodder should not be used on any field where crops are to be grown which are liable to infestation, for the following reason:—This kind of Eelworm can be passed through the animal along with the digesting food without being harmed, and therefore is just as likely as not to be carted out within the manure from the yards to which it was brought in within the straw. For this reason superphosphate or guano have been recommended in preference to manure which may have been made from infested fodder, or which *may have had infested plants thrown to rot on the heap.*

This point is well worth attention, as it very probably accounts for the patches, large or small, of infestation in fields where otherwise all is free. In a valuable paper of researches on *Tylenchus devastatrix*,* published by Dr. Ritzema Bos on July 1st, 1887, a list is given of various wild and cultivated plants which are known to be liable to infestation of this Eelworm, and the list throws great light on the method by which infestation may arise. Amongst corn and grasses Oats and Rye are noticed as infested, and Wheat as having been found diseased in the same manner as Rye but much less severely. The Sweet Vernal Grass, Annual Poa, and Meadow Soft-grass are mentioned as liable to infestation, and the pest has been found to occur in small quantity in the Common Buttercup, the Daisy, and the Common Plantain known as Ribwort: likewise in Shepherd's Cress, Sow Thistle, also common weeds; and the wild and the cultivated Teazel are both subject to attack. Buckwheat is noted as liable to severe attack, and the Common Onion is recorded in the list as suffering annually in Zeeland and South Holland from severe attack of this *Tylenchus devastatrix*. Other weeds and cultivated plants are mentioned in the list, but at present, in this country, as far as we have worked out, Clover† and Oats are the only plants which suffer severely.

Without going into further considerations, it has been clearly shown that where there has been an infested crop one year, it is

* Untersuchungen über *Tylenchus devastatrix*, Kuhn, von Dr. J. Ritzema Bos.—Biologisches Centralblatt, vii. Band No. 9, 1 July, 1887.

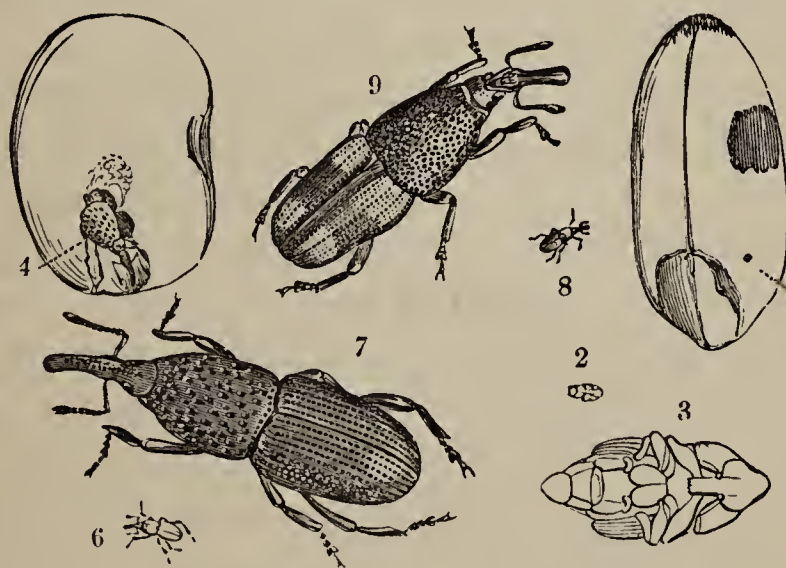
† See 'Clover-sickness,' pp. 1—9 of this Report.

almost certain, or at least exceedingly likely, that there will be an infested crop in the following year, if anything is put in liable to attack; therefore it would be eminently desirable *not* to put in such crops immediately.

Barley has been experimented on by Dr. R. Bos and found *not* to take infestation, and in the notes of Mr. Greig, of Peterhead, at p. 67 it is remarked of this attack that a “crop of Barley after Turnips appears to stop it for that time.” Peas and Beans appear to be safe, and Wheat just to have a possibility of taking it, but to suffer very slightly. Where infestation is established in the field, excessively deep ploughing is a remedy, for the wormlets cannot make their way up again; but even moderate ploughing, if the *surface slice* is well turned down, does much good, as it is mainly at the surface that the wormlets which have left the plants lie, and a good dressing of caustic lime or gas-lime applied before ploughing would probably also do good. In favourable circumstances the wormlets may live on for years, supporting themselves on various kinds of weed-food until a suitable crop recurs. But by the above-mentioned measures they may be so buried or starved, or poisoned, that what may survive will be too few to do much mischief.

This treatment of the land; a safe crop immediately succeeding an infested crop; care *not* to bring back infestation to the fields; and all points of good cultivation calculated to push on a healthy growth, are the best measures that can be used to counteract Eelworm disease.

Common Granary Weevil, *Calandra granaria*, Lin.; and Rice, or Spotted Granary Weevil, *C. oryzae*, Lin.



CALANDRA GRANARIA and C. ORYZÆ.

6, 7. Granary Weevil; 2, 3, chrysalis, nat. size and mag.; 8, 9, Spotted or Rice Weevil, nat. size and mag., likewise infested grains, mag.

The Granary Weevil can perhaps hardly be said to take a place among crop-pests, as the growing corn in the fields is precisely the

place where it is *not* to be found; but as when the corn is stored this small weevil is apt to be one of the worst pests of our granaries, it requires some mention.

These small beetles are of the shape figured above at p. 71, rather more than the eighth of an inch in length, and furnished with a long snout, and they may readily be distinguished from the kind figured with them by being of a pitchy brown colour. The Rice Weevil as it is called (but which might be more conveniently known as the Spotted Granary Weevil) figured page 71, is usually distinguished by having four paler spots above. This kind is excessively injurious to imported grain of various kinds, but it does not as far as we know increase here, on account of the weather not being warm enough for its multiplication to any observable extent.

Our regular Granary Weevil, so to distinguish the British *unspotted* kind, feeds in maggot-state in most kinds of corn, notably in Wheat and Barley, especially doing harm in malt, and also attacks Rye and Maize. The female beetle makes a hole with her proboscis or snout in a corn-grain, and lays an egg therein—one egg in each grain which she attacks. The maggot, which soon hatches, feeds on the flour of the grain and turns within it to chrysalis state, from which the weevil soon comes out. Increase is very rapid; it is considered “that in the course of a week one female can lay up to as many as 150 eggs,”* and consequent destruction of grain is very great. To gain an idea of their powers I have placed a small heap of corn in a loft near an infested granary, and very shortly the weevils found it out and (though they are wingless) crept to the heap, and in a short time riddled a large proportion of it. It is supposed that the beetles feed on the flour of the grain to some extent, as well as the maggots, which often nearly clear the inside out, and amongst a number of this *Calandra granaria* which I have by me, in order to watch their habits, I find the beetles collected in parties in the outside skin of Maize grains. This points strongly to the *Calandra* feeding in beetle state, because one grain of Wheat or Rye is enough or more than enough for the nourishment of the one maggot which lives in it; therefore where the much larger Maize-grains are reduced to mere outer films, it appears there must have been the beetles as well as the one maggot at work to clear it. This matter is of some importance, in consideration of damage, as it explains why these beetles may be found in flour, which is not, as far as we know, used by them for egg deposit, or for rearing the young.

In the course of last October I received samples of these weevils, with which some sacks of flour sent to a large public institution had

* ‘Insekten kunde,’ by Dr. E. L. Taschenberg, pt. ii. p. 173.

been found perfectly infested,* and in all probability these weevils had made their way into the flour from infested corn or granaries or stores, in which places they harbour in all available chinks.

In September I received a box with samples of these same Granary Weevils, of which the sender, writing from a farm in the North of England, remarked that they “are a great trouble to me in my granary. They attack Wheat while it is in the garner or in bags. . . . They seem to multiply very quickly and eat all the inside of the grain.”

On the 1st of November I received a note from a correspondent in the London district, mentioning that his “Barley and malt were swarming with weevil.”

A few days later he further noted (with specimens of the beetle sent accompanying)—“There was a large quantity of malt of last year’s make which was kept over, as is generally done, in a bin, and when it was screened we found it to be simply swarming with weevil. This is a very common occurrence, as all know who have to do with malt. I have reason to suspect that they were introduced into my house by some foreign Barley, as grain-ships often swarm with them.” There is no doubt that grain-ships are infested by the *Calandra* or Granary Weevil, as well as our own home stores, and in the note† is appended a method of sifting out the weevils and dirt, which might with great advantage be much more generally made use of, especially if the results of the operation were forthwith destroyed.

There was formerly an opinion that this weevil left the corn heaps in winter. This, however, does not appear to be the case where the

* I do not give the names of localities of my correspondents on Granary Weevil, as, although this attack exists all over the country and has been known as injurious here for at least more than fifty years, names of special localities of presence might be unpleasant, precisely to those who are doing most to get rid of it.

† “When the cargo is very badly affected—when the whole bulk seems alive as I have myself seen them on very hot summer days—it is a common practice for merchants to spout it, *i. e.*, to shoot the grain down a spouted trough, in which at the angle is a wire sieve with meshes large enough to let the weevils pass through, but not the corn, which runs into the granary or into sacks, as the case may be. By such means the quantity of weevils and dust sifted out is enormous; and this appliance is generally so situated at the wharves that the beetles are deposited near the edge of the wharf or even in the river-bed, and if not naturally washed away at high tide are swept into the water, their destruction being thus easily accomplished. The great heat generated in a bulk of weevily corn is caused by the dust arising from the borings and frass of the insects. The weevils themselves are generally to be found inside the granaried heap or cargo of corn, unless the weather is very hot, when they are especially lively on the outside.”—From ‘Granary Weevils, *S. granaria* and *S. oryzae*,’ by Edward A. Fitch, the ‘Entomologist’ for Feb. 1879, pp. 42—43.

heaps are large enough to form a good shelter. One of my correspondents states, "I find that the weevils infest the Barley-malt, and do not come out unless disturbed. We have lately been doing this, and as a consequence find them in all the available chinks and crannies. . . . In my case the heap was amply large enough to afford them shelter and protection from chills, consequently until disturbed they were not found at any distance from the malt-bins. But even if they do not leave the corn-heaps as a regular matter, they are to be found in chinks and crevices, and between planks and wood-work all about stores where corn is kept, and it is from such places that they come out to infest new supplies."

For requisite treatment I believe no better advice can be given than that conveyed in some of the concluding words of the paper by Mr. E. A. Fitch, of Maldon, Essex, which is previously quoted from. From the careful study Mr. Fitch bestowed on the subject, as well as his personal observation of the matter in his own stores, his digest of the measures which can be serviceably used is of much value :—

"Cleanliness alone will do the required work, and this requires to be thorough to cope with such a crevice- and cranny-loving hybernating insect as the *Calandra*. Frequent lime-washing and scrubbing (with soft soap) of granaries, the plastering of all uneven wall-surfaces, the asphaltting or concreting of all unlevel floors, the free use of the dressing-machine or blower, and frequent sifting or turning over of the grain are the only likely remedies against weevil attack. It is also necessary to guard against mixing sound Wheat with any containing weevil, except for immediate grinding; also to see to the destruction of all rubbish and tail-corn in which it is possible for beetles to live and breed.*"

The love of warmth of the weevils may be turned to account in the German method of trapping them. This is to lay a sheepskin, wool downwards, by the corn heaps; here the beetles collect, and are so entangled that with care they may be carried away and beaten out of the skins and destroyed.† As warmth is requisite to their breeding freely, everything which will keep down the temperature of the infested corn is useful, more particularly as, where they are in great numbers, considerable heat is engendered (as is well known in the case of infested corn-ships) by the results of their accumulations of frass or workings. This is so well known that I have received enquiries from shippers as to whether "the heat generated the beetles." This is certainly not the case. It is the beetles and maggots which generate the heat; but at the same time the heat is so favourable to their reproduction that under such circumstances they

* 'Granary Weevils,' by E. A. Fitch, the 'Entomologist,' Feb. 1879, p. 50.

† 'Insekten kunde,' by Dr. E. L. Taschenberg, pt. ii. p. 174.

multiply the quickest. In Germany "air-drains" are used to cool the heaps, and this is considered the surest way to prevent damage. Drain-pipes are laid in various directions through the heaps, and the temperature of the heaps and the surrounding atmosphere is thus considerably lowered.

Turning or stirring the heaps, which is strongly advised, answers the same purpose; and in the following communication, a member of a firm largely interested in imported grain, especially draws attention in the passages which I have marked in italics to the importance of turning the Wheat in *frosty weather*, and of keeping up a *good draught*.

"We unfortunately have had a great deal of experience of the mischief done by these animals. They breed very rapidly, we find, in warm weather, particularly in Wheat from Russia; but can *usually be got rid of by turning the Wheat in frosty weather, if the warehouse is in an open situation with a good through draught*. Sometimes during a mild winter it is impossible to get rid of them. This was the case in the winter of 1884-85; we lost between £1000 and £2000 on a single cargo of Russian Wheat from this cause. Some seasons, such as the summer of 1886, they seem to do but little harm.

"As a rule, weevils are imported every year in Russian and Indian Wheats, and do more or less harm in the autumn, but are got rid of in the first severe frost. Occasionally weevils imported in distant cargoes do not seem to breed at all. We had an Australian cargo in bags in 1885 in which there were a good many weevils in the sweepings, but these never seemed to breed or increase."

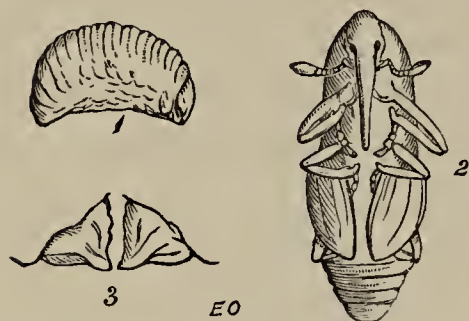
These would very likely be the *Calandra oryzæ*, which, though very destructive in imported corn is considered not to breed—or at least not to any extent—in this country, consequently on the temperature not being warm enough for it.

In regard to this matter I tried some experiments, extending from the beginning of September in 1877 to the latter part of October in the following year, and I give an abstract of the observations, as I am not aware of other notes regarding propagation of this kind of Granary Weevil in England having been published.

Life-history of Calandra (Sitophilus) oryzæ, commonly known as Rice Weevil, although found in several kinds of grain.

The observations were made on weevils from the sweepings of corn-ships (known as "Indian dust"), taken from imports from the East Indies. These were sent me on the 5th of September, 1877, and at first the weevils refused to have anything to do with the English Wheat I sprinkled amongst them, straggling away in preference to the broken Maize scattered amongst it; but on the 19th of September, the punctures where the egg had been inserted were plainly noticeable.

These were on the concave side, and usually at the end of the grain occupied by the germ, where the outside is softest. On the 9th of March of the following year I found numerous Wheat-grains, each containing a maggot. These were of various sizes, from about the sixteenth to under the eighth of an inch in length, white, thick, and



Maggot and chrysalis, and jaws
of maggot of Rice Weevil;
all much magnified.

fleshy, legless, with chestnut head and jaws also chestnut-coloured; darker at the extremity; bluntly pointed and waved into two blunt teeth (see fig.). A few chrysalids were present, but at the above date they were all dead, in different stages of development. About a month later (on the 11th of April) no more chrysalids had formed, and at the beginning of June I only found two more beetles, and though

about one grain in ten had a tenant, for the most part it was only still in maggot state and often stunted, and in the few grains which contained a developed beetle this was usually small, distorted and dead. On the 6th of October following I found numerous beetles, but still not by any means corresponding in number with the infested grains of corn, and some of these beetles only about half the usual size.

In the early part of the experiment I placed the beetles in reach of fire-heat, which threw them into a very active state; afterwards they were in the temperature of a living-room constantly used,* and as even with this the result was that in the course of fourteen months I only obtained one brood, and this not as numerous as the parent weevils, and even of these some were half-sized or variously not in a natural condition: *from these points it appears that the non-breeding of this Spotted Granary Weevil in England to any hurtful extent is much confirmed.* This kind is usually easily known by the four lighter spots on the wing-cases.

In dealing with Granary Weevil, which are amongst the most common of our dry-corn pests, we have an enemy of which we know the history, and the habits, and that with due care it may be kept in check within our granaries, and be prevented from being brought to where it may be spread to them, likewise it *cannot* do harm to the growing crops.

But great risk, to my thinking, lies in the use of the foul screenings which get spread abroad in the country by reason of their cheapness. It is quite open to possibility that Hessian Fly thus came to us; because, as we now know, the chrysalids are to be found in the fine

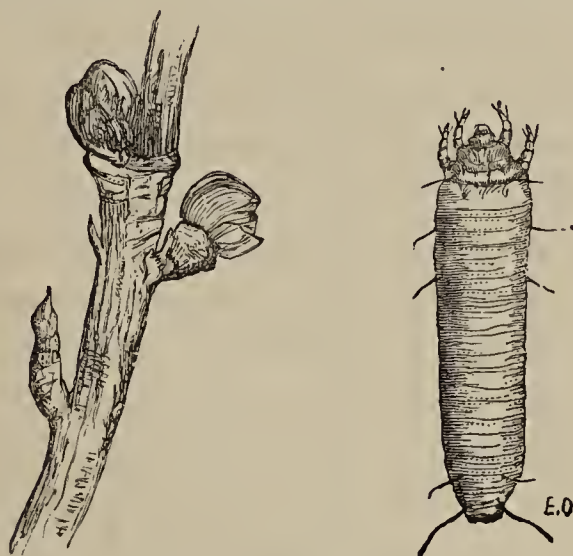
* For full detail of the experiments see the 'Entomologist' for February 1879, pp. 51—54.

siftings of small seeds and rubbish thrown down by the threshing-machines from infested corn, but also the coarse screenings out of bodies larger than the corn itself are greatly to be mistrusted. Amongst these I have found the most various things, as short pieces of straw that might or might not have maggots within, knots of maggot-web, ergot, &c., showing that the worst field-attacks may thus be propagated from the insects developing from this source.

It may certainly be laid down that, wherever these cheap foul screenings are allowed to be used, the holder must not be surprised if grave disaster should follow in the train.

BLACK CURRANT.

Gall Mite. *Phytoptus ribis*, Westwood.



PHYTOPTUS (? species.)

Black Currant shoots with infested buds. Gall Mite.*

The Black Currant Mite has been reported as seriously troublesome to growers at various localities. With the increase of fruit farming the attacks of this *Phytoptus* or Gall Mite have either much increased or the observation of them has much increased during the last few years, so as to have become in some localities—as for instance in Clydesdale, as mentioned—a very troublesome evil.

In my Ninth Report I gave a description of the kinds of *Acarus* or Gall Mite, of the sub-family of *Phytoptus* which causes this Black Currant attack; therefore it is only necessary to mention that it is

* The figure given is of the Birch *Phytoptus*, and shows the general appearance of the *Phytopti*. I am not aware that distinctions in form between the two kinds have been noticed.

much too small to be seen by the naked eye, and is of the shape figured p. 77, that is, cylindrical, rather smaller towards the tail extremity, and furnished with only two pairs of legs, placed at the fore part of the body. It has also some large strong bristles, which may help it in movement. *Phytopti* multiply from eggs, and are the same shape and possess the same number of legs throughout their lives. They live together in large numbers, and in the case of the Black Currant do damage by causing a swollen growth of the buds, which ends in causing them to prove abortive. The presence of attack may very easily be known by the appearance of these buds, which are spherical or variously swollen or distorted; sometimes they are few in number, and the growth of the shoot on which they are placed is not distorted; sometimes as many as six or seven swollen buds may be found on about three inches of shoot.

The two following observations give a very clear description of the main points of the *Phytoptus* attack, and also of the great difficulty of getting rid of it when once it has fairly taken possession.

The following note was sent me on the 15th of March, by Mr. W. James Le Tall, from Hackenthorpe, West Sheffield.

“I have been advised to ask if anything is known of an insect which infests Black Currants and destroys their power of fruit-bearing, the buds of the infested trees being very much enlarged in spring, and never bursting forth into buds and blooms at the usual time. If the disease once gets into a plantation of Black Currants, it passes from tree to tree till all are infected, and from being a fruitful plantation it becomes in three or four years almost fruitless. At this period of the year the buds of the infested trees show unnatural vigour. An insect at this time of the year is also found plentifully in the infested buds; and I should be glad to know if anything is known of its life-history. To me it appears about from 1-80th to 1-100th of an inch long, and if seen with a half-inch object-glass it appears to have four legs at what I take to be its anterior part, and the body is pyriform, with, at the smaller end, some arrangement by which it seems to be able to affix itself after moving with its four legs.”

“No cure is known for the disease here but destroying the infested trees.

“This disease I have noticed for fifteen years, but now it is very much more prevalent, and threatens to destroy the Black Currant crop in this vicinity.”

Specimens of remarkably bad *Phytoptus* attack were sent me on the 26th of May, from Midway Paynton, Cheshire, by Mr. E. Dowlen, with the observation,—“Enclosed are some branches of Black Currant, in which the leaf-buds are all ruined owing to the presence in them of small white grubs. In this district, during the last few

years, the Black Currants have suffered severely from this pest, the entire stock of trees in some cases having been completely ruined, and fresh stocks which have been put in, though brought from a distance, have shared the same fate." . . . In this case, as in that above reported from Clydesdale, it appears that the mites have taken such complete possession as to make land useless for Black Currant growing without something being done. The branches sent showed very bad attack of the *Phytopti*. As many as seven diseased leaf-knobs, from a quarter to three-eighths of an inch across, were on one of the Black Currant shoots, which were only about three inches long. Other shoots had seven or eight of the swelled leaf-buds on them, and with them were sent specimens of Hazel, also badly attacked by *Phytopti*, which could be plainly seen with a one-inch object-glass.

The following note, sent me on the 24th of December, by Messrs. Dicksons and Co., 1, Waterloo Place, Edinburgh, also shows strongly the great difficulty of getting this mite out when once it is established. Messrs. Dicksons enquired whether I could suggest "any cure for the 'mite,' as it is called, which attacks Black Currants in some parts of the country. A grower in Lanarkshire informs us that the buds become abnormally enlarged, and the pest, whatever it is, has so thoroughly spread over the district in the Clydesdale orchards that it is considered hopeless to attempt to grow Black Currants at all there. Our correspondent thinks it must be in the ground, as he has got plants successively from England, Scotland, and Ireland with similar results, and they all become affected in the same way as those which had been taken out. Once, when he removed the old soil and replaced it with fresh material, the pest did not attack the bushes till the third year after they were planted, but then those bushes were bad as any that had been there before; apparently, cutting off the affected branches would not do any good, as young shoots coming up from the ground are badly infested the first year. The affected bushes produce no fruit. Could anything be applied to the soil to destroy the pest?"

I am not aware that the general habits of the Black Currant Mite have been observed, but in the case of *Phytoptus* attack to other plants I have found them straying about on the leaves, and in the case of Birch *Phytoptus* I have found the mites active enough to lay eggs in winter; therefore it seems likely that the surface soil where many Black Currants are grown may easily get infested by the leaves and many of the mites falling to the ground together in autumn; and as they are still active they can creep about at pleasure, and more particularly lodge themselves together with leaves and rubbish that collect amongst the lowest part of the branches at ground-level. It would appear likely that skimming off just the top surface with the old leaves, as soon as they have fallen in autumn, would do a deal

of good, of course taking care to work well in round the neck of the branches at ground-level so as to get out all harbour for the mites.

If to this was added, smearing the lowest part of the branches for about two or three inches high with the material called "Davidson's composition" (which answers excellently for keeping insect pests from crawling up trees or plants), it would appear impossible that attack could be started from mites crawling from the ground. Where bushes are only slightly infested, breaking off the swollen buds and *destroying* them should be carefully looked to. It is little use breaking them off if they are dropped about, and also good strong syringings with soft soap for the main ingredient would be very useful. These would run down and lodge in all the chinks and crannies; under rough bark between buds and shoots; in the angles of the branches; in short, just the place where the straggling Currant Mites harbour, and would kill what were there, and likewise by the greasy and deterrent mixtures harbouring would make their hiding-holes quite unattractive and unsuitable for shelters.

The following recipe, sent me in 1885, by Mr. Arthur Bull, of Cottenham, Cambs.,* would be serviceable:—

"Two parts of sulphur and three parts lime boiled together in water (2 lbs. sulphur and 3 lbs. lime, 3 gals. water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes."

Or, to save the trouble of boiling the lime, sulphuret of lime may be used—4 ozs. of the sulphuret and 2 ozs. of soft soap to each gallon of water. The two ingredients should be well mixed before the addition of the water, and be stirred as the water is poured on at *boiling* heat. This may be used as a syringing, or in thick condition run down at the bottom of the bushes to choke and poison what lodge there.

Where bushes are badly infested they should be destroyed, but this should be done carefully. If the branches are just carelessly thrown for a while on the beds, the mite is very likely indeed to spread from the broken bits to the healthy bushes. The branches should be *cut and immediately carried away* and burnt; the stump should be grubbed out and also burnt; and the surface soil displaced in the operations should *not* on any account whatever be spread about, or it will probably convey the mites with it. If it is turned down again into the hole, and some fresh gas-lime spread on the spot, this would make all safe, and probably sprinklings of gas-lime under the bushes, or thrown in a ring round the bottom of the branches would be very useful. Care should be taken that it did not touch the bark, and that

* See 'Ninth Report on Injurious Insects,' p. 35.

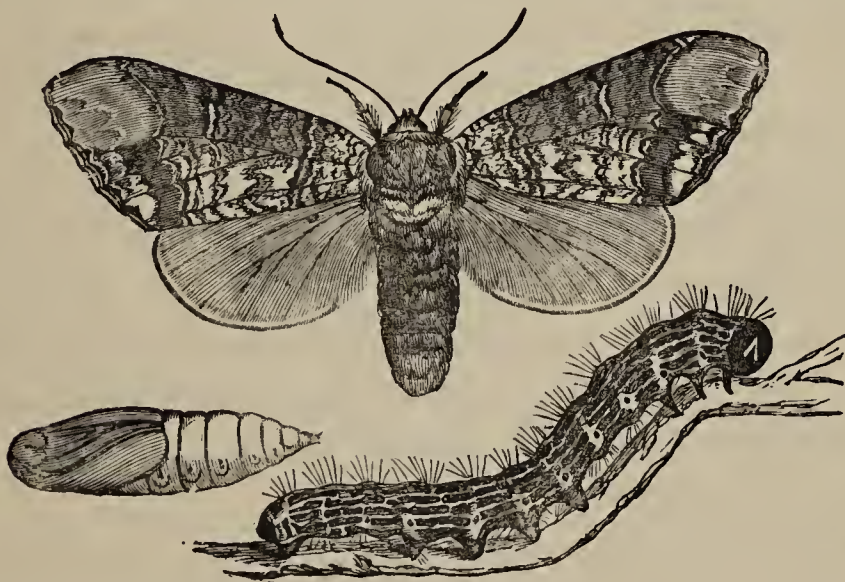
it was applied by some one who was acquainted with the destructive nature of the material if used too freely.

It does not appear that this *Phytoptus* or Gall Mite attacks Red or White Currants, therefore (so far as we know) replacing the destroyed Black Currant-bushes with the other kinds would be of service. Likewise, as this attack spreads to such a serious extent where Black Currant bushes are grown together in large areas, as in fruit farming it might be worth consideration whether growing the different kinds in alternate rows or plots would not be desirable.

There are many different kinds of deformed growth which are caused to various plants or trees by Gall Mites or *Phytopti*. The well-known distorted growth of the twigs of the Birch into great masses of a foot or a yard in length, popularly known as "witch-knots," is one form; the "nail galls," like small crimson spikes, found on the Maple and Sycamore leaves is another form; and the Gall Mites which cause them are considered to be of different species, but whether they limit their attacks entirely to their own food-plants does not appear to be known with absolute certainty at present.

ELM.

Buff-tip Moth. *Pygæra bucephala*, Stephens.



PYGÆRA BUCEPHALA.

Female moth, caterpillar, and chrysalis.

The Buff-tip Moth caterpillars often do great harm to the leafage of various kinds of trees. From their great size and voracity the presence of attack is very plain, and though there is from their habits every likelihood of this attack being repeated, if nothing is done the

recurrence may be easily prevented. For several years I have seen the caterpillars regularly straying about towards autumn near lime trees in the neighbourhood of Isleworth; and they have been forwarded to me as causing damage in the Royal Botanic Gardens, Kew; but I have never seen them in such numbers as in the bunches of specimens forwarded to me last season.

The above figure gives a good representation of the full-grown caterpillar; the colours are black and yellow, with black head, black horny plate above the tail segment, and orange transverse bands on each ring. The large moth is easily known by the black or rusty lines and figures on a pearly or purplish ground, with a large yellow or "buff-tip" to the fore wings, whence the moth takes its name; the hinder wings are whitish.

On the 27th of August I received specimens from Mr. T. Cradock, of Ockbrook, Derby, which he had taken from a broad-leaved Elm. He mentioned, "when I saw them first, about 12 o'clock this morning, they were in hundreds on one large branch, and had entirely stripped that one branch of its leaves. It was that which attracted my attention to them. On going again this evening, about 6 o'clock, I could only find a comparatively small number; there might perhaps have been then only four score."

The above description is characteristic of the method of attack. Sometimes the whole tree is stripped of its leafage, but more commonly only the twigs of the higher branches or those outside are stripped; and the method which is said to answer best to get rid of the caterpillars is to jar the boughs or shake the infested twigs so sharply and suddenly as to make the caterpillars fall. Where there is a garden-engine at hand or means of throwing water, probably nothing would be so effective as good drenchings.

When the caterpillars are full-fed they creep down the trees, and turn to dark brown chrysalids in the dead leaves or rubbish beneath the tree or just below the surface of the ground. If these are left undisturbed, naturally the moths, which come out from them in the following June, fly up to the tree above and start attack again. The eggs are usually laid about the middle of the summer in patches on the upper side of the leaves.

Where trees are known to be infested it is serviceable to make a circle of gas-lime, or of a ring of wet tar run out on a rough rope of hay, or of anything else that the caterpillars will not creep over; thus they are confined in a narrow space at the foot of the tree, and if the surface of the ground is skimmed off at leisure during the winter the chrysalids can be thus readily got rid of.

The Evergreen Oak has not, so far as I am aware, been noticed as one of the trees which they infest; but in the course of last October I

received specimens of this caterpillar from Kilmacurragh, Rathdrum, Ireland, which were forwarded on twigs of this tree, with a note that it was the first time the sender had seen this kind on Evergreen Oak. The caterpillars were remarkably fine specimens, and were feeding voraciously on the Evergreen Oak sent with them.

H O P.

Hop Aphis. *Phorodon humuli*, Schrank; *Aphis humuli*, Schrank.

During the past year the subject of the migration of Hop Aphis from Plum to Hop in the early part of the year, and from Hop to Plum in the late part of the season, has been so thoroughly investigated as to make it appear fully proved that this regular migration to and fro does take place. It has long been considered by many Hop growers that migration occurs, and it has also been definitely stated to be the case by observers competent to distinguish the precise kind.

So long ago as 1854, Prof. C. L. Koch recorded that he found Hop Aphis on Plum and Sloe; and it is worth notice that he mentions the great numbers in which it was found on these trees or bushes in the latter part of May, and that he gives the description of this Hop Aphis in its various stages (that is female, young, &c.) from what he saw on the Plum and Sloe; and after details of these, then he adds . . . "In the month of June this kind of Aphis quits the leaves of the Sloe" (or wild Plum) "and then betakes itself to the wild and cultivated Hop, where it settles on the under side of the leaves, sometimes in immense numbers."* This and other observations, unnecessary to repeat here, show spring migration on the continent of Europe.

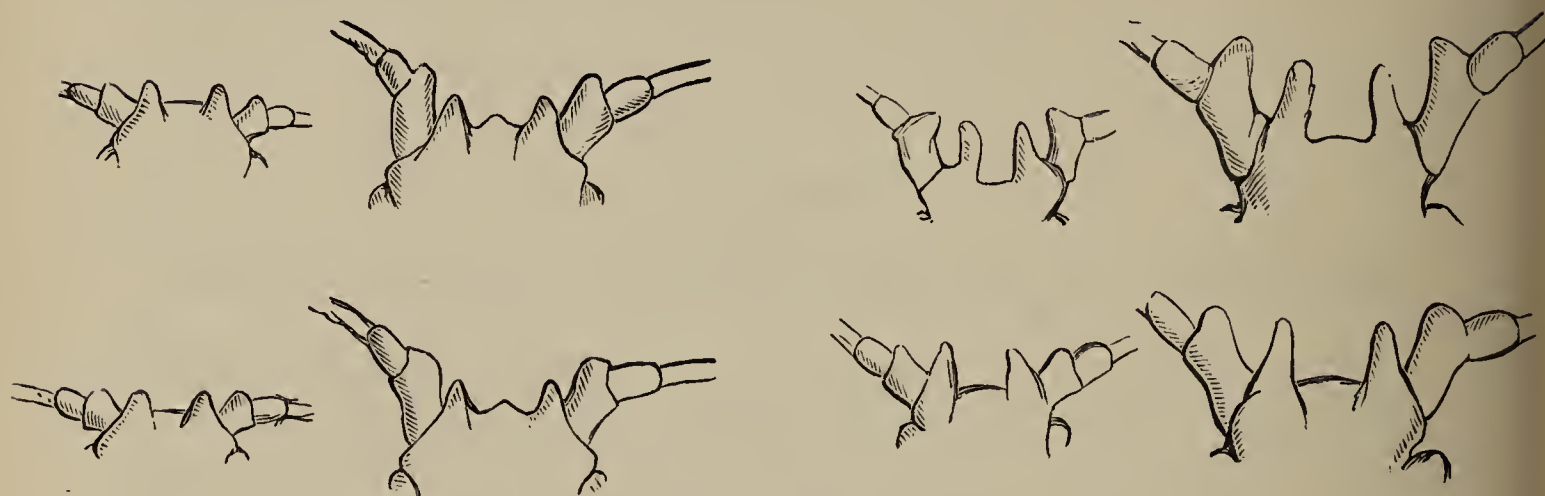
In this country, after long examination of the Aphis in the conditions commonly called Fly and Louse (that is winged and wingless), and including young, more advanced young, and females, I could not find that any difference in form of the characteristic points of structure (by which the Hop Aphis is known) were to be noticed between the kind technically known as the *Phorodon*, which was found on Hop, and that found on various kinds of Plum.†

The figures show the almost exact similarity of shape in the frontal tubercles, and of the swollen or toothed lowest joints of the horns of the Hop and the Damson Hop Aphis, that is *Phorodon*, found

* 'Die Pflanzen Lause (Aphiden),' von L. C. Koch, pp. 114—116.

† See Eighth Report on 'Injurious Insects' (Hop Aphis), pp. 43—56, with figures to show similarity of form in forehead and base of antennæ between the specimens taken respectively from Hop and Plum.

respectively on Hop and Damson or Sloe, in their conditions of young of two ages and of winged and wingless females. These were figured from life by myself; the reader will observe that the upper row was drawn from Hop Aphides, the lower from specimens taken from Damson or Sloe.



PHORODON.

Young.

Winged females

More advanced young. Wingless females.

The upper row from Hop; the lower row from Damson or Sloe.

The observations sent in and the specimens all appeared to point, as I then said, that there was good reason for believing “That *the* great attack, which usually occurs in the form of Fly about the end of May, comes on the wing from Damson and Sloe as well as from Hop, and that the Hop Aphis and the Damson Hop Aphis are very slight varieties of one species, and so similar in habits as regards injury to Hop that for practical purposes they may be considered one.”

It is of very considerable importance to prove these points certainly, as thus it is proved also that Hop-grounds near Plum and Damson orchards and Sloe-hedges are likely to be infested; and also that where there is presence of these orchards, there washing betimes will prevent much attack going on to the neighbouring Hop-yards, and also that it would be very desirable to substitute some other plant than Sloe for hedges.

The spring migration to the Hop appeared to be certain, but the autumn migration had not been so fully entered on; and therefore the abstract of observation given below, partly taken in America and partly in this country, will be found to be of much value.

In the American States the Hop suffers severely from Aphis, and consequently careful investigation of the above points have been made by Prof. Riley, Entomologist of the Department of Agriculture, U.S.A., and under his direction for practical use. During his recent stay in England I had the advantage of personal communication with Prof. Riley on the subject, and he favoured me with a copy of his paper, read before our own British Association at Manchester, and

likewise was good enough to write me the main points of his investigations in Kentish Hop-yards during his stay in England, which, it will be seen, clearly prove egg-deposit of the Hop Aphis taking place on Plum in autumn.

Prof. Riley reported before the British Association as follows* :—

“*Phorodon Humuli* hibernates in the winter egg-state, this egg being fastened to the twigs (generally the previous year's growth) of different varieties and species of *Prunus*, both wild and cultivated. The egg is difficult to detect, because it is covered with particles which resemble the bark in colour and appearance. It is usually laid singly, and when freed of disguising particles is seen to be ovoid and 0·04 mm. long.”

From Prof. Riley's report it appears that the annual life-cycle is begun on Plum by the female, the mother of the coming tribe being hatched from the winter egg. She is described as stouter than the individuals of any of the other generation, and as having legs, horns and honey-tubes relatively shorter, and the tubercles between the horns as hardly observable. The colour pale green, with bright red eyes and faint dusky feet.

Three generations are stated to be produced on the *Prunus* or Plum, of which the third becomes winged, “and instinctively abandons the Plum and migrates to *Humulus*,”—that is to the Hop. Here Prof. Riley makes the important observation, “*The habit of moving from plant to plant after giving birth to an individual, and thus scattering the germs of infection on Humulus, is well marked in this winged generation.*”

In the observations reported by Prof. Riley which were made in America (on growing plants and in *vivaria* at Washington, and checked by others made at the same time in Hop-yards at Richfield Springs in New York State) it was considered to be the case that “during the development of the three Plum-feeding generations the Hop is always free, and subsequently, until the return of migration, the Plum becomes more or less fully free from infestation by this species.”

[In the above point I incline to think that there is a difference between the condition of Hops in America and England, as regards freedom from infestation until it comes from Plum on the wing, and this for reasons to be presently given.—ED.]

The existence of many generations on the Hop during summer we are all well acquainted with, but during Prof. Riley's stay in Europe, and more especially in England, he personally observed the point not previously worked out, of the autumn migration of the Hop Aphis

* The above extracts are taken from the “full abstract of a paper read before Section D of the British Association for the Advancement of Science, Manchester, Sept. 3rd, 1887.”

(the *Phorodon Humuli* that is) from Hop to Plum. The accounts of this he published at the time in more than one of our leading journals, but I give a few of the most important points, from communications which I have been favoured with from himself, showing the progress of the movement on to Plum in the autumn.

On September 15th Prof. Riley wrote me from Maidstone,—“As I anticipated, I have found *Phorodon Humuli* just migrating from Hop to Prune, and first wingless generation on Prune, but no eggs yet.”

On September 24th also, writing from the neighbourhood of Maidstone, Prof. Riley noted, “*Phorodon* swarming on Plum-trees here.”

On October 1st Prof. Riley wrote me that he had now brought the *Phorodon* investigations to a successful close, and completed the whole life-cycle. “Last week pairing was everywhere going on, and on Saturday I noticed the first eggs. The Plum-trees are now being rapidly stocked. The male is winged and the female wingless, as I had surmised, and the first generation on the Plum is the sexed one.”

Further, Prof. Riley informed me that the Aphis eggs (which he had seen on the Plum-shoots) became black. This agrees with information sent me by various correspondents during the last few years, that they had noticed black eggs, of which they sent me specimens, from which they had no doubt they had hatched Hop Aphis.

We have now got the complete circle of observation of the life-history of the Hop Aphis, as far as Hop and Plum and Sloe are concerned; and it appears plain that washing in the Plum orchards betimes will cut off one great cause of infestation to the Hop, but in a further consideration, although I scarcely like to venture to differ in any way with such a thoroughly well-skilled observer as Prof. Riley, yet, as we have discussed the point much in friendly conversation, I will venture to say that I do not myself think that in this country *the whole of the attack* comes on the wing from Plum, Damson, or Sloe.

I think this because we have found Aphides (that is, wingless females and lice) on Hop as early as the end of March and the beginning of April, long before the attack coming on the wing made its appearance. Also in the Stoke Edith experiments, made in 1884,* it was found that in the case of the Hop-hills which were dressed with applications to keep the Aphides from coming up from around the Hop-plant, the vines on these hills (more than six hundred in number) were free from attack, *although the rest of the Hop-yard was infested*, until the fly came on the wing about the end of May.

This matter of the amount of attack to be found early in the season on Hop needs further enquiry, and I should be very much obliged by infested shoots of Hop being sent me as early in the season as they may be observed, for thorough identification of the species.

* See my ‘Report on Injurious Insects’ for 1884.

K A L E.

White Cabbage Butterflies. *Pieris brassicæ*, Latr., and *P. rapæ*, Latr.



PIERIS BRASSICÆ.

1, Female of Large White Cabbage Butterfly; 2, eggs; 3, caterpillar; 4, chrysalis.

The caterpillars of the White Cabbage Butterflies were destructive last year at various places, on Kale, Cabbage, and "Green-crops." They were reported as "more common at Staines than they had been for five or six years."

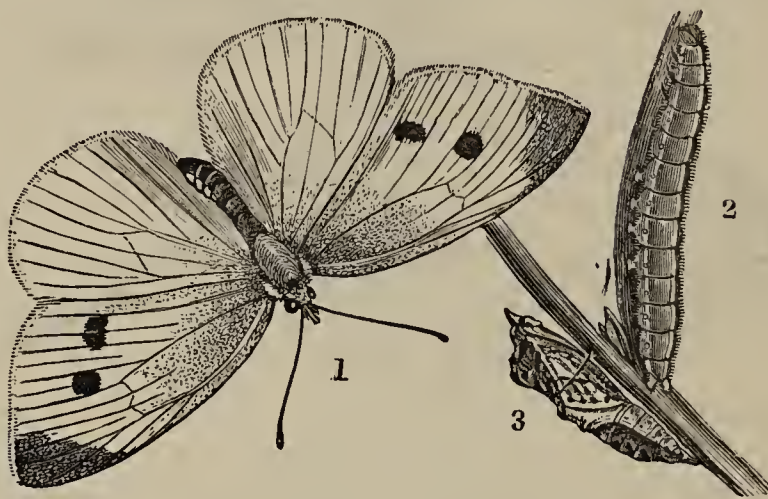
At St. Alban's I found them on Cabbage or Cauliflower plants in my garden at Torrington House, when I moved there in September, in such numbers as to attract the attention of every one who came near. The position was very warm and sunny, sheltered from the north by a high garden wall and the ground sloping rapidly down to the valley with a S.S.W. exposure, and the caterpillar swarmed to such an extent that some of the plants were eaten down to complete skeletons. This was a case in which hand-picking would have saved the crop, but being much occupied from change of residence I could not attend fully. Many of the caterpillars, as is their custom, wandered away, and, after crawling away about the width of the garden down the hill and over the wall, went into chrysalis on the sunny side.

This habit of the caterpillar is one great means of checking increase; it chooses such places as sheltered spots on walls, under eaves and copings, in garden sheds, and under old wood, &c., that may be lying about, to change to chrysalis in. There it hangs itself up by

the tail, and, after spinning some threads for support, throws off its caterpillar skin, and appears as a pale green chrysalis spotted with black. The autumn brood passes the winter in this condition, and from these chrysalids the butterflies come out in spring. It is therefore desirable during winter to examine likely places about kitchen gardens for the chrysalids to be found in and to destroy them. They may sometimes be thus collected very rapidly in large numbers.

The caterpillar of this kind—the Large White Cabbage Butterfly, figured above—is, when full-grown, bluish or green above, with yellow line along the back and each side and large black spots.

The caterpillar of the Small White, figured with its butterfly below, is velvety green in colour, without black spots, but with three yellow lines, and the chrysalids are fleshy brown, freckled with black.



PIERIS RAPÆ.

1, Small White Cabbage Butterfly ; 2, caterpillar ; 3, chrysalis.

The same methods of prevention and remedy are for the most part applicable to both the Large and Small kinds.

The following note, from Mr. W. W. Glenny, of Barking, Essex, shows the great amount of caterpillar presence, and also that they may be kept down by hand-picking :—

“ Our main plague this season was the Cabbage caterpillar, whose activity was surprising, and who would have done me considerable damage, except that I watched his movements with an army of boys, who picked him off wherever and whenever observed. We had to keep a sharp look-out over three or four fields, and retrace our steps now and again as fresh ova were hatched. By careful and close attention the damage was minimised, and the loss brought within reasonable compass.”

In the following notes of bad attack on Kale sent me by Mr. Joseph Ackworth, of the Howberry Farm, Erith, it will be seen that two methods of prevention occurred, one by weather-influence, one by attack of parasite insects : and as far as appears, both these methods might be turned to account artificially.

On the 29th of July Mr. Ackworth wrote me, with a specimen accompanying, that the attack "at the present time is doing us incalculable mischief among nearly all our green crops. . . . We have spent a lot in hand-picking and yet they swarm, as I believe fresh broods are continually hatching.

"What I want more particularly to ask your opinion of, is the mass of yellow silky substance we are now finding, wherever the caterpillars are, and invariably one is stretched across these and half dead; and in one instance there appeared to be small grubs or maggots hatching therefrom and feeding on the caterpillar. At first, when hand-picking, we smashed these, but we are now perplexed as to whether this is advisable."

The above is an excellent description of the early condition of a small, black, four-winged, parasitic fly (scientifically the *Microgaster glomeratus*, Linn.), which is one great means of checking increase of Cabbage Butterflies. This parasite ichneumon fly lays its eggs in the butterfly caterpillar, within which the parasite maggots feed, until the caterpillar on which they are preying has reached its full growth, or more, as these caterpillars full of maggots may often be known by their large size. The maggots then come out, and each spins a small yellow case like a small silkworm cocoon, and the infested caterpillar dies just when otherwise it would have been turning to chrysalis. The little clusters of yellow cocoons may be seen in great numbers where there are many Cabbage caterpillars and should never be destroyed, as the flies from them will do good again with the next generation of caterpillars. The clusters or bunches of cocoons may be easily collected and thrown aside under boards or in sheds or any convenient shelter, without needing any further trouble.

On July 29th Mr. Ackworth wrote that, "thanks to the ichneumon fly so many caterpillars were found dying, that from this, with a heavy recent shower, the field was then nearly clear of the pest"; and he further added, "we continued hand-picking the smaller plants, and I hope now we have got through the worst of it."

The help given by the heavy rain-shower is well worth notice. Sudden rain will sometimes so affect Cabbage caterpillars that they become mere lax skins, with cream-coloured fluid within, and it would be well worth trying, where water and means of applying it is at hand, whether thorough drenchings applied by engines would not have a similar effect.

Waterings or "washings" of weak brine or soapsuds have been found useful, and in the case of the Large Cabbage Butterfly, which lays its eggs *in patches under the leaves*, as figured at 2, p. 87, it would be worth while to have these looked for and the bits pinched off and destroyed.

PEAR.

Slugworm of Pear and Cherry Sawfly. *Tenthredo cerasi*, Linn.



TENTHREDO CERASI.

Slugworm and Sawfly magnified, with lines showing nat. length; cocoon.*

During the past season I received an unusual number of applications regarding Pear Sawfly caterpillar. These caterpillars are exceedingly voracious, and whilst with a little care they may easily be got rid of, or the chrysalids to which they turn may be cleared from the upper part of the soil beneath the infested trees, on the other hand, if nothing is done by way of remedy, the foliage of the trees is greatly injured, and the attack is likely to recur year after year.

They may easily be known by their peculiar shape and slimy appearance, from which they take their common name of "Slugworm." Until their last moult they are of a blackish colour and lumpy shape, much like that of a slug, swollen or enlarged behind the head, or may be at the middle or nearer the tail. They have ten pairs of feet,—that is to say, three pairs of claw-feet, which are on the three segments next the head, and seven pairs of sucker-feet, so that each segment excepting the head and tail, and the fourth segment from the head, has a pair of claw- or sucker-feet, but from the small size of the grub they are little noticeable. When full-grown it is about half an inch or rather less in length, and looks as above-mentioned somewhat like a slug, or still more like a lump of wet blackish dirt run together, and largest at one end; but at this stage of life the Slugworm entirely changes its appearance. It casts its skin and appears as a yellowish coloured caterpillar, no longer slimy nor smooth, but wrinkled across.

The caterpillars now go down into the ground and there they spin themselves up in cocoons, from which, in the case I am quoting from, the Sawflies came out in the following year in July.

* The above very excellent figure is from one in Vol. ii. of the 'Gardener's Chronicle,' which I was favoured with permission to use by the Editor some years ago.—E. A. O.

The figure at the head of this paper shows the form of the Slug-worm and cocoon, and likewise of the Sawfly, with lines showing the natural length; and I have had plenty of specimens of the Slug-worms, but the precise determination of the species, which was first described in England by Prof. Westwood, is involved in so many difficulties, that I refer the reader who wishes to go into these points to the work below cited.*

The first note I received of this attack last year was sent on the 21st of July, from Hencotes, Hexham, by Mr. W. A. Temperley, who desired information regarding the "black, leech-like caterpillar" of which specimens were forwarded. He mentioned, "It made its first appearance here last year, but is swarming on some of the wall-fruit trees this season, Cherry-trees especially, and has destroyed the foliage. It first appears like a bright speck, almost invisible to the naked eye.

On the following day, July 22nd, specimens of Slug-worms in different stages of growth, were sent me from Dorchester, by Mr. Geo. Oldfield, agent for Mr. W. E. Brymer, with a note that this "jelly-like grub" was doing great damage to Pear trees in the gardens of Mr. Brymer. It was observed that, "the grubs were in hundreds on the leaves, particularly on the top of espalier and wall-trees, and seem to suck the juices from the leaves, which turn brown and die."

On the 2nd of August specimens were forwarded me, together with leaves gnawed on the upper surface in small dots or spots up to patches of half an inch to an inch and three-quarters in length. These were sent from Bryntirion, Bridgend, Glamorganshire, by Mr. W. Prichard, with a note that the small grubs, of which a sample was enclosed, had in about three days devoured the leaves of two Pear trees, and were then attacking a Quince. "The same grubs appeared on the same trees last year, clearing them entirely of their leaves."

A little later on, August 23rd, specimens of the same attack were sent me by Mr. M. Edmonds (by desire of Mr. Elwes), from Colesbourne, near Cheltenham, with the observation that the grub had "attacked a Pear tree, situated at the east end of the house, for three successive years," and entirely spoilt the fruit. "Every leaf is perfectly brown as the one I send to you."

On September 13th, Miss E. Culverhouse sent Slug-worms from The Hundred Acres, Sutton, Surrey, with a note, "They were now attacking in large numbers the leaves of a row of Pear trees trained against a brick-wall, east aspect, chalk soil. The upper sides of the leaf in full hot sunshine are covered, but *not one* on the under; . . . the

* Mon. of the Brit. Phytophagous Hymenoptera, by P. Cameron (Ray Soc. 1882), pp. 226 and 228.

leaves when attacked soon turn brown, wither, fold, and drop as in winter."

On September 23rd, Miss Culverhouse wrote that the insects had largely increased in numbers, but that the remedies which I suggested (noted below) had been tried; and that the liveliness caused by the application of lime-dust, and consequent exudation of slime, soon disappeared on a second application, and their eradication soon would be complete.

On September 15th specimens of this same kind of shiny caterpillars were sent me from Serlby Hall, Bawtry, Yorkshire, with the observation that they had devastated a long wall of Pear trees, so that the leaves had turned quite brown and were falling off.

The Slug-worm attack can be checked by dusting or syringing. The caterpillars, if annoyed by throwing a caustic powder on them, such as quick-lime or gas-lime, can throw it off at first by exuding a coating of slime, and thus as it were moulting off the obnoxious matter; but they cannot keep on continuing this process; therefore a second application of the powder (of course soon after the first) takes effect and kills them. If a good time is allowed to elapse between the dressings, they will have regained the power to produce the slime exudation, and the dressing will do little good. Tobacco-water, lime-water, and syringings are all stated to be of service, but it is desirable the syringings should be applied early or late, as before 7 o'clock in the morning or 5 in the afternoon.

The recurrence of the attack, which, as it will have been observed in the above notes, is a very common circumstance, may be prevented by skimming off the surface of the ground and removing the cocoons. These may lie below the surface at from one to about four inches deep, according to the state of soil. If the earth is stirred over by a competent observer, little balls, probably much resembling the colour of the earth they are in, will be found, and may at once be identified by just tearing the spun case open, when the caterpillar or, later on, the chrysalis will be found within. When once the observer has found how deep these cocoons lie, it is easy to have the surface-soil removed to just below that depth, and by removing this and *destroying it, with the cocoons within it*, the infestation may be fairly carried out of the place; but care must be given that the cocoons *are* destroyed, or otherwise the Sawflies that hatch out of them will fly back to the trees and begin the attack over again.

It might probably save a deal of trouble, in the case of espaliers or wall-trees, when the flies are seen to be infesting them, to run a length of tarred cloth or paper beneath the boughs, and shake them well morning or evening. The flies are stated to fall and to remain motionless for a short time; this would allow of them being stuck fast to the tarred surface which they fell on, and would save much egg-deposit.

PINE.

Small Pine Sawfly. *Lophyrus* (? sp.).

On the 28th of June I was favoured by specimens of Sawfly caterpillars, sent me from Happy Land Park, Bishop Auckland, Co. Durham, by Mr. J. Ilderton Leaton Blenkinsopp, with the observation, "I send you a branch of a tree from a young plantation which is being devoured by caterpillars. They eat all the trees (Scotch Fir), excepting this year's shoot, which they leave." The twigs or sprays of Scotch Fir sent were fairly loaded with the masses of Sawfly caterpillars hanging one on the other, and the bark as well as the leafage was being consumed.

The caterpillars were 22-footed, and when they spun up formed a cocoon which was easily compressible with the nail, nearly three-eighths of an inch in length, of a yellowish colour outside, and lined within with two layers, separable with care from each other. The outer layer, next the cocoon, of a deep black grey colour; the inner layer, next the larva (which was still unchanged to the chrysalis state on January 25th), of a lighter grey.

When the caterpillars were sent me at the end of June they were just near the time of spinning up, and the colour varied a good deal both in tint and depth of tint, and some of the caterpillars were darker in the stripes than others, so that I could not identify the species beyond the fact of their not being larvæ of the common Pine Sawfly,*

* The figure of the common Pine Sawfly is appended, although it is larger and the caterpillar differently marked to the kind found at Bishop Auckland, just to give an idea of the form of this kind of Sawfly, and of its many-footed caterpillar.



LOPHYRUS PINI.

Pine Sawfly, caterpillar, and pupa, magnified; and gnawed Pine leaves.

as they were (amongst other points) much smaller. When they spun up they were little more than half an inch in length, with shining round black heads, three pairs of black claw-feet, and eight pairs of sucker-feet of a pale greenish colour. The general colour of the caterpillar was grey or greenish grey, with two darker stripes along the back (dividing the lighter grey into three stripes), beneath the lowest pale stripe a black stripe, and lower, just above the sucker-feet, a stripe of fine black spots. The caterpillars were pale green below, and above were transversely banded with rows of minute dark tubercles. In many points they much resembled the description of the *Lophyrus rufus*, Kl.; but not having developed the perfect fly I cannot tell the species with certainty. They did not appear exclusive in their food, for not having Scotch fir at hand I placed some *Arbor Vitæ* in their cage, and found them presently clinging to it, and marks of gnawing on the leafage.

On the 2nd of July many of the caterpillars had spun their oblong cocoons. These were from two- to three-eighths of an inch long, cylindrical, and bluntly rounded at the end, varying in tint from whitish to yellowish or brownish tints, and shining and membranaceous in texture. The caterpillars did not appear to be disturbed by being watched, and I was able to observe one specimen which had formed its case, excepting about a sixth part, which was needed to complete one side, still placing its thread. In this instance the house appeared to be finished by closing up at the side, the ends being completed previously.

About six days later, that is on the 8th of July, there were still some caterpillars that had not spun up, but a large number had formed their cocoons. These were for the most part placed amongst the leafage of the shoots on which they fed, or on the stems which they had stripped, which were laid on earth. Some were placed singly, but for the most part they were spun near or close together, in bunches,—one, or two, or three dozen, so as to form closely-packed lumps of cocoons, or sometimes two or three, or half a dozen together.

On application for further information towards the end of January in the present year, I was favoured with a number of cocoons, about half of which were empty; and also the following serviceable account of the attack, sent me by Mr. Geo. Burgess, agent to Mr. J. I. Leaton Blenkinsopp:—

“In reference to the Pine Sawfly, I observed the flies in the early part of May last year. In June the branches of the young Scotch fir trees were covered with caterpillars. . . . We applied quick-lime, also petroleum-oil, which made them leave the branches. I do not find so many cocoons under the trees where the lime and oil were applied. The grubs eat all the foliage of the Firs, except the young shoots that

came on the trees last summer. They left the trees when all the previous year's foliage was eaten off. There were no cocoons on the trees, but plenty about *half an inch under the soil* (under and near the trees). The trees are from six to ten feet high, and about nine years' growth. I have not seen any flies *since June* last; part of the grubs appear to have left the cocoons, but I cannot say if they are last year's cocoons that the Sawflies have come out from."

Rather more than half of the fifty cocoons sent me in January were empty, but from the irregular form of the opening I should conjecture that the caterpillar inside had been taken by small insect-feeding birds, as the titmice, or the field-mouse or field-vole, both of which are stated when pressed by hunger to feed on Pine Sawfly cocoons. In the specimens sent me I observed that the bark was gnawed, and Mr. Burgess remarked that from this cause "the turpentine or resin is now exuding from the small branches of the trees."

On a neighbouring property the forester got rid of the attack by employing people to crush the caterpillars which were devouring the foliage, in their hands.

The above information confirms what is considered one of the best methods of getting rid of the pests, namely, making the caterpillars fall by throwing dressings or by shaking. If this was done early in the attack, either over rough cloths, so that the fallen grubs could be collected and destroyed, or with bands of Davidson's composition (which would stick fast the grubs that tried to go up the trees again), daubed round the base of the stem, this would do a great deal of good.

The best time for shaking is said to be in the early morning, when the caterpillars are somewhat torpid; and it is stated, by Prof. Th. Hartig, that in German forestry one man to shake, with two women or children to spread a cloth beneath the boughs to catch the fallen caterpillars, will clear fifteen trees of twenty-five years' old before nine o'clock in the morning. Where the trees are small, the plan of crushing the caterpillars by drawing the shoot through a strongly-gloved hand answers well. Where circumstances permit of the upper surface being skimmed and the rubbish burnt with the contained cocoons, this is an excellent way to prevent recurrence of the mischief; but as the details of how to deal with this attack have been previously given, I mainly mention the above as being an instance of mischief caused by a somewhat different kind to the one most commonly observed, and of which I am endeavouring to complete the whole life-history.

TURNIP.

Turnip Grub. *Agrotis segetum*, Westwood.



AGROTIS SEGETUM.

Turnip (or Dart) Moth, and caterpillar.

The surface-caterpillars, and more particularly the special kind known as the “Turnip grub,” which is figured above, together with the moth to which it turns, are now one of the regular insect troubles of the year. The grubs are of a dingy greenish or purplish brown or smoke colour, with two darker lines along the back and one on each side, but the colouring and depth of marking is very variable. They have a few dark spots on the segments, these spots being arranged transversely on the second and third segment from the head, which is brownish, and the grub is furnished with three pairs of claw-feet, and with four pairs of sucker-feet beneath the body, and another pair at the tip of the tail. The grubs when disturbed roll themselves up in a tight ring. The moth has the front pair of wings freckled and marked with black, or some shade of brown or greyish, and the hinder wings mainly of a dirty white.

The method of life is for the grub to feed during late summer and autumn, then during winter to feed or to hybernate in cells it makes well down in the earth, so as to protect it from too much cold; and if all has been favourable to the grub it comes out again in spring, and also feeds again, until in May or June it turns to a smooth brown chrysalis in the ground, from which the moth comes out in about three or four weeks. This caterpillar is now so regularly mischievous that the attack needs attention and experiment to find what could be done to check it. Excepting when very young, these caterpillars feed almost entirely below the surface of the ground, and are considered to attack almost any kind of plant that is eatable, but are chiefly injurious to Turnips, Swedes, and Cabbage. They have also been reported in the last few years as doing mischief to Mangold, Oat-plant, and Celery;

and either this kind or some of the nearly-allied kinds of surface-caterpillars prey on Leeks and Onions, Bean-plant, Spinach, Carrots and Potatoes.

As this attack has been so often entered on before, I give the following notes of locality of observation last year as shortly as possible, excepting where some special information is conveyed.

On August 11th they were reported to me as doing considerable harm to Swedes at Llansannor Court, Cowbridge. On the 11th, Mangold and Swede roots were noted as attacked on ground at Street, Somerset, by from one to four grubs at the root of the plant. On the 12th, Mr. J. Penrose Fitzgerald, writing from West Park, Midelton, Co. Cork, Ireland, mentioned the grubs as being found in the ground under Turnips and Mangolds, and occasionally under Potatoes. "They appear to eat the tap-root of the Mangold, which when attacked droops and falls. They are all through the district in light medium soils."

On August 24th, Mr. C. E. Mason, writing from Marton Grange, near Newport, Shropshire, reported that the grubs had attacked the Turnips in great force, and were of the same kind which had done so much damage to the Turnips in 1868, which was also a hot dry summer.

On September 4th, specimens of the grub, which were attacking and destroying Swedes in large numbers, "three or four to each root," were sent me from the Boyce Court, Gloucester.

September 6th, specimens of the same kind, which had destroyed a whole field of Swedes by burrowing at the roots, were sent from Reynolds Place, Horton Kirby, Dartford.

On September 19th, different ages of the grub, one about a third grown, were forwarded by Mr. Alex. Frazer from Westerfield House, near Ipswich, with the note, "They are eating off the thousand-headed Kale-plant just at the crown." A little later Mr. Frazer wrote, "We have gathered many hundreds of the grubs, one from under each Cabbage-plant that was eaten away, and have replanted them and all look well."

On September 18th, Mr. H. J. Sheldon, writing from Brailes House, Shipton-on-Stour, sent the following note of the great mischief which this same kind of grub was causing. . . . "But I am suffering terribly, and so are all my neighbours, from our Turnips and Cabbages being devoured by the enclosed grub. There are thousands of them, and they clear the ground of everything green. Would you kindly let me know what they are, and, still more, can you tell me how to get rid of them? They do not care for either lime or salt; and they will make a clearance of every Turnip and Cabbage in the country, if we find no means of destroying them." He further added, "They gnaw all the Swedes, Turnips, and Cabbage-plants through the root just

under the ground, and are clearing the fields of all plants of the sort."

A little later Mr. Frazer wrote the following note, showing the serviceableness of hand-picking, *if it could be managed at a paying rate*, the apparent uselessness of trying to kill the grubs with quicklime, and some remarks about the amount of attack being different on land differently prepared.

Mr. Frazer wrote :—"I have followed your advice and put some people on to hunt for the pests round the Cabbages with a knife and dig them up, but it is a very slow job. They find as many as five or six at nearly every plant that begins to droop, and doubtless there are countless numbers all about the ground.

"They have eaten off about four acres of Swedes and about the same quantity of Yellow Aberdeen Turnips, and are eating a lot of White Turnips, as fast as they get any size—and have eaten a large quantity of Cabbages. I replanted 40,000 and they have eaten them all again. I cannot think that lime and sulphur would be any good against them, as I have put quicklime on them, after digging them out of the ground and it does not kill them—their skins are too thick. They are only on the ground that has been kept cultivated and prepared for roots in the summer. I have four acres of Cabbage planted on Wheat stubble, just mucked and ploughed, and they have not touched them.

"They are only on all the land that was prepared for roots, and are eating a crop of Rape lately sown on some clay land that has been a dead fallow all the summer. It would require an army of people to hand-dig and pick them all over 100 acres of roots, and I fear they will do me irretrievable damage. I see they have also done a lot of harm to my neighbours.

"Unless one could get at them in the moth state, before they lay their eggs to form these grubs, I fear they are invincible."

On the 19th of September Mr. John Coleman sent specimens of the same caterpillar from Quarndon, Derby, with a note that the "large grubs were making sad havoc of everything green in the garden."

On the 20th a similar report was sent from the Manor House, Everleigh, Marlborough, by Mr. C. W. Curtis, of the grubs making great havoc of the Swedes on his farm. "Many acres have been destroyed, and I hear my neighbours have also suffered. They seem to attack the root in numbers, and as many as fifty-seven were taken from one Swede."

The following report was sent me on the 21st of September, by Mr. Lewis Danford, from Langley Bromfield, Salop, and I insert it at length, as, besides general points of interest, it is noted that mineral

superphosphate only was used for the Swedes. Mr. Danford reported—

“Field of seven acres. Has been under the four-course system to my knowledge for eighteen years; light soil. During the eighteen years, with exception of two straw-crops in succession, *viz.*, Oats after a light crop of Wheat (this two years ago), manure used good fold-yard with turnip manure, and for the present crop of Swedes mineral super only, some six or seven cwt. per acre. The Turnip-crop came up ‘patchy’ and was resown, but to no good; some three acres in the field are without roots; this in patches. On starting to plant Ox Cabbage this morning to fill up gaps, my men found the grubs as sent you; and on examining the field myself I found, with few exceptions, all the *large* Swedes, together with the small as those sent, eaten like those sent you. At a root I could always find two, and in many cases from five to nine grubs, including always a worm of the description sent you, located in the eaten hole of the root.”

A little later on Mr. Danford wrote that he tried my suggestion of collecting the grub from the root, but as they were in, some two to four inches, it was necessary to dig or remove the soil all round the Swede, then replace it. “This I found far too expensive an operation, so I have let them alone. I purpose next week to clear off what remains of the crop of Swedes and then scuffle the field some four or five inches deep. This will, I fancy, turn up the grubs on the surface, and the Crows, Rooks, and Plovers will doubtless feed on them. I could not turn pigs in until the crop was raised, but I shall do so when the field is scuffled. In a garden adjoining this field the owner tells me he finds numbers of grubs in digging his potatoes.”

On the 29th surface caterpillars were sent me from Kemble House, near Cirencester, with the note that they had entirely destroyed the Turnip crop round there this year; and on October 4th Mr. W. Biddulph further wrote of the grubs, “You cannot realize, unless you were to see them, what a pest they are. . . . Unless they are killed down this winter by the frost it will become a most serious matter.”

On October 3rd Mr. J. G. Edwards sent samples of surface caterpillars from Broughton Stockbridge, Hants, with a note that they were “destroying Potatoes, Swedes and Cabbage, and other plants in fields and gardens, in a serious manner. Soot and salt have been tried in vain.”

The attack has continued during the winter, for at times previous to the beginning of January I have received information from Mr. F. W. Silvester, Hedges, St. Alban's, that surface caterpillars were still amongst his Turnips, and on the 16th of January the following communication regarding Turnip Grub, was sent me by Mr. Edgcombe Parsons, from Coates, near Cirencester.

Mr. E. Parsons requested information "respecting a plague of grubs from which my farm for some months has been suffering.

"They first made their appearance in June last (being then very small) in my root-crops, first attacking the leaves, afterwards the roots themselves. Some eighty acres were cleared entirely, not even a weed being left alive in the fields. Some Rye also was damaged in the autumn.

"I find now that the whole of my fields are infested with them more or less; the specimens I send you to-day I found after the plough a few days since; they were then in a lively state. . . . I find that they soon get back again into shelter, after having been turned out with the plough."

From the reports sent in during 1887, and the three preceding years, it appears that this attack is prevalent and destructive in the more southerly, eastern, and midland parts of England; but I do not find that notes have been sent in of it occurring farther north than Selby and Market Weighton, in Yorkshire, but as for remedies, or means of prevention, we seem just as far off as ever.

Various chemical applications tried in unmixed form have had no effect. Col. G. Coussmaker, of Westwood, Guildford, who has for some time paid much attention to the grubs, informed me that he "put several grubs into bottles of soot, sulphur, salt, but they only burrowed straight down, as if wishing to get away from unpleasant quarters, and remained coiled up at the bottom of the bottles. After letting them alone for two days I took them out seemingly uninjured, and have put them into a bottle full of earth. There they have been for upwards of three weeks, without a bit of green food, and are to all appearance as well and lively as ever."

On the 23rd of January in the present year, Col. Coussmaker further mentioned, "I told you that I found the crop dwindling away very fast, and that I got a family of Hop-pickers, father, mother and three girls, to pick the whole field systematically. They went over the seven acres twice, and in sixteen days collected sixteen quarts."

[We certainly greatly need some experiments tried about this yearly recurring pest, when the only known way of really extirpating it is one of such trouble and cost.—ED.]

One note was given regarding nitrate of soda having been previously used on the land without any immunity from attack following, and likewise that the grubs were as plentiful where a good deal of lime had been applied as elsewhere.

Other notes mention some good coming from the use of lime, but there does not seem to be any method which can be commonly worked at a paying rate, that can be trusted to as a remedy. Where it can be done, hand-picking is a certain way of getting rid of a large

amount of the grubs; and in cases like the field Cabbage-growing near Isleworth, may be presumed to answer as it is practised, but this is very different to working out the grubs from the large-leaved root-crops.

Well stirring the surface with hoes and drags has been found to answer, by throwing out a portion of the grubs to Starlings, Rooks, &c.; also *Pigs have been found to search busily for the grubs*, and here we may very possibly have one means of prevention that can be used at little cost.

It seems plain that the attack, which begins each year about August, cannot come from any other source excepting from the eggs laid by the moths which appeared a little before, about the middle of the summer, from chrysalids in the ground. We *know* that the caterpillars turn to chrysalids in the ground about May or June, and from all this it seems to me that where fields are known to have been infested it would be highly desirable, when they are being ploughed in the winter or spring following the ravages, to look whether the caterpillars or brown chrysalids were being turned up by the plough, and if so to have them hand-picked by children at so much a quart, or to turn on pigs to root them out.

The caterpillars or chrysalids *may*, of course, be more or less in many places, but we know that they *are* present in legions in many fields, and therefore that these infested fields are the places from which the moths will be likely to come out in corresponding numbers and infest the neighbouring fields; and therefore, as far as we see at present, it appears that we have no better way of forestalling attack than to look out for and destroy the grubs in infested land.

PART II.

OX AND HORSE WARBLER.—OX GADFLY.—“MURRAIN”
WORM.—SHEEP’S NOSTRIL-MAGGOT.

WARBLER.

Ox Warble Fly. *Hypoderma bovis*, De Geer.



HYPODERMA BOVIS.

During the past year a very great advance has been made towards proper attention being paid to getting rid of Warbles by the strong approval of the work set on foot for its destruction, given both by many of our most leading public agricultural bodies, and a very large number of private individuals connected with cattle, both in Great Britain and Ireland.

Our own Royal Agricultural Society, in co-operation with the Newcastle Hide Inspection Society, assisted greatly; likewise the Highland and Agricultural Society of Scotland, and the Scottish Chamber of Agriculture. Foremost amongst our English Chambers of Agriculture which aided in the work I may name that of Wisbech, Lincolnshire. The Butchers’ Association of Birmingham, agents on various of the great properties, local agents, and cattle auctioneers and salesmen, and a very great number of cattle-owners and breeders, likewise aided, both in drawing attention to the importance of the work and in many cases by bearing witness to the ease with which this pest might be got under.

On the 10th of June Mr. J. McGillivray, Secretary of the Hide Inspection Society, Newcastle-on-Tyne, with whom I had for some time been in correspondence, wrote me that it had been considered by the Committee of the Society that it would be useful to have a few

warbled hides, both fresh and tanned, exhibited at the then forthcoming Show of the Royal Agricultural Society of England at Newcastle, in order to draw attention of the many cattle-owners who would be present at the meeting to the importance of taking steps to prevent the attack, and to let them judge for themselves of the serious loss occasioned by it.

The time having been passed at which, according to rule, applications for standing ground for exhibits could be received, some difficulty occurred, but, in consideration of the importance of the subject, special permission was obtained from the Royal Agricultural Society, and Mr. Jacob Wilson as Manager of the Royal Show granted an excellent site for the exhibition of warbled hides, and I had the pleasure of in some degree co-operating by lending specimens, &c.

The exhibits consisted of the hide freshly taken from the infested animal, so as to show the horrible state that such a hide presents where the flesh side can be seen with the great swellings containing the maggots more than an inch long, with the putrescent matter oozing where the swellings have been cut across and other evils no way observable on the outside of the hide of the living animal. Tanned hide was also shown, and hung against the light, so that the riddled state caused by the maggot holes could be clearly seen, and amongst these I exhibited the hide of a yearling (presented to me by Messrs. Parsons, of Taunton), which had died of mortification of the back, consequent on the presence of more than four hundred Warbles.

Maggots and other specimens were also shown, and copies of my own four-page illustrated note* giving an account of the method of life of the Warble maggot, and the very sure, cheap, and simple way in which the attack may be remedied and prevented, were presented to the visitors by one of the Staff of the Hide Inspection Society, and one of the members of the Committee devoted the greater part of four days to attendance in the tent to give all necessary information to visitors. The great interest excited by the exhibits was reported to me from various quarters, but is best conveyed in the following portions of a semi-official account with which I was favoured by Mr. Jos. G. Angus "As a Member of the Committee of the Inspection Society, I take considerable interest in the Warble question, and devoted the greater part of four days in attendance at the tent.

"I am sure you will be glad to learn that the experiment succeeded beyond our most sanguine expectations. Thousands of visitors I

* This four page note was printed for distribution, and as the main points of the method, and means of preventing or remedying attack, could hardly be put in fewer words, I reprint most of the "note" with the figures, as an addition to this paper, and shall be happy to forward copies gratuitously to applicants, or to offer any information on the subject.

believe realized for the first time the real loss to the community. From conversations I had with cattle-breeders, farmers and others, I think we may fairly expect as a direct result of the show :—

“1st. That a large number who have hitherto let things take their course will now take the trouble to destroy the Warble *when it is apparent on the hide*.

“2nd. Many will perhaps smear their cattle *before* the Warble is perceptible, and save the animals much unnecessary suffering.

“3rd. Not a few will in future adopt the best-known method of preventing the deposit of the egg. *I was glad to learn from several practical men, who in consequence of your published observations on the subject took precautionary measures two years ago, that they have cleared their farms of the pest, and believe that they run very little risk from their neighbours, as they do not think the fly travels far.* [I have placed this in italics to attract attention as it is confirmed by the accounts sent to myself year by year in every point, and that of the fly not travelling far should especially be observed.—ED.] Should this prove to be true, the extinction of Warbles need only be a question of time.

“Fortunately I had opportunities of seeing several of the large cattle exporters from the Continent, and was much pleased to find them so easily roused to the importance of drawing attention to the matter in their own countries. Of the thousands of live cattle brought to the Tyne yearly from abroad, a very large proportion are badly warbled.

“I am by no means scientific, but as a buyer of about 1500 to 1700 hides per week, I have the ravages of this pest constantly under my notice.”—Jos. G. ANGUS.

At the end of May Mr. F. M. Menzies, Secretary of the Highland and Agricultural Society of Scotland, favoured me with information that he had distributed 1300 of the papers above mentioned, and likewise Reports (giving the subject in fuller detail), to the Secretaries of Local Agricultural Societies in Scotland, together with a circular drawing attention to the importance of the subject, and further added from himself :—“I hope we may *rouse* the farmers to endeavour to *eradicate* the pest—it is so easily done :—my own cattle used to have plenty of them, but from squeezing out the bots they appear to have been got rid of, as I have not found a bot for some years.”—F. M. M.

A few days later Mr. D. Currer, the Secretary of the Scottish Chamber of Agriculture also wrote, mentioning that he had already been distributing some of the above papers “amongst my Directors, and some of the larger rearers, and breeders of stock,” and proposed to continue the distribution.

By the co-operation of the two above powerful societies, the subject

of Warble attack and the means of prevention were thus laid before agricultural centres throughout the whole of Scotland. In England several of the Chambers of Agriculture assisted in spreading information, especially that of Wisbech, under the Presidency of Mr. W. C. Little; and also with the very hearty co-operation of Mr. Geo. Moore, Hon. Secretary. On Thursday, the 10th of March, a meeting was held to consider the subject, and an able paper was read from Mr. W. Hatton, of the Firm of Hatton Brothers, tanners, Hereford, alluding amongst other things to the following very important point to which I have myself endeavoured to gain attention:—"As a tanner I cannot omit to mention the large number of yearlings lost annually, and generally supposed to have died from "black leg" or a chill, but I have seen hundreds of skins off such animals, most of them so thoroughly occupied by grubs along the back that one need not seek for any other cause of death."

Mr. J. A. Smith, of Rise Hall, Akenham (Hon. Secretary of the East of Suffolk Chamber of Agriculture), similarly forcibly, but taking different points, gave information as to damage caused by these most unnecessary causes of loss, and how easily the attack might be got rid of.

A resolution was passed, that "in the opinion of the meeting, the extermination of the Warble from the hides of the cattle in this district is highly desirable, and the members present pledge themselves to use their best endeavours to take steps to prevent the animals suffering from the attacks of the fly in the ensuing summer."

Mr. George Moore, the Hon. Secretary of the Chamber, had especially devoted attention to the subject for a long time previous to the meeting.

The Butchers' Provident and Trade Association, of Birmingham, as well as their President, Mr. T. J. Rodway, lent cordial and powerful assistance. The aid of the leading Agricultural and in many cases of the Local Journals has been widely accorded, and of enormous service. At the time of the Newcastle Royal Agricultural Show the Newcastle Journals gave much co-operation, and in Newcastle itself as well as its neighbourhood, I received great assistance in promoting the subject, and much time and thought were bestowed on it by Mr. F. C. Smith, who from his connection with Mr. Bolam, Cross House, Westgate Road, Newcastle, (Messrs. Bolam have been connected with the lead agency for about 150 years), and also from being personally interested in the subject, had great opportunities of collecting and dispersing information.

Mr. F. C. Smith, distributed copies of the papers to the tenants on estates under Mr. Bolam's management, who were much pleased to have them, and promised to act on the advice, and likewise to Bailiffs

and other out-of-door workers on the estates, and also supplied the Cattle Market, and left copies at the Farmers' Club, and at the working Mens' Club, which being placed in the Butchers' Market is much frequented by those interested in stock, and distributed and communicated in many other quarters likely to be serviceably influential in drawing attention to the subject.

Application was made to myself by several hundred correspondents, namely, cattle-owners, agents of large properties, cattle-salesmen and auctioneers; their letters in many cases contained accounts of the great prevalence of Warble in the district written from, and the loss to the owner on hide, milk, health or condition of beast for slaughter, according as he himself was personally interested in the respective matters. The printed note was requested for the information of the writers, and in many cases further supplies were desired for distribution to neighbours, tenantry, or customers; and in this manner about 21,500 copies of the four-page note, giving a short account of the main points of the attack, were distributed in the country, as well as many hundreds—probably about 3000—of the reports.

If it is considered that some four years ago the nature of Warble attack and the remedies were scarcely known in this country, excepting to a few especially interested in the subject, the fact that plain information is now at the command of everyone, and is being spread abroad with the approbation and under the auspices of the leading Agriculturists of the Kingdom, gives great reason to hope that we are in a fair way now to get the mischief attended to. One great point, that is still to be undermined with the uneducated, is the view that the attack is sometimes of incomprehensible origin, and shows a good state of the animal!

The following notes sent from various parts of the country refer to this extraordinary idea:—

“Having had to do with cattle, both when feeding or slaughtered as beef, all my life, I have for some time before reading your articles, seen how erroneous the old idea was that Warble maggots were ‘Thriving Bumps;’ whether the name is peculiar to this part of the country I do not know.”—ERNEST MEAD, 1, Western Road, Tring.

“I find it most difficult to make them (Stockmen and Cowmen), believe that the maggots are not a sign that the beast is doing well; they call them Thriving Bugs.”—K. M. COURTAULD, Cut Hedge, Halstead, Essex.

“I have some difficulty in getting the Warble grubs removed, as there is a notion prevalent in this district that a few of them make an animal thrive, and I know very few who take the trouble of removing them.”—J. PUREFOY POE, Harley Park, Callan, Ireland.

“Having distributed your papers among my fellow-farmers, I am sure they will be well appreciated, for my own district is so very much infested with the Warble pest, and the old fashioned farmers call them Thriving Bumps, but I think they are *vice versâ*.”—HENRY R. BROWN, Lodge Farm, Harefield.

Mr Richard Stratton, of the Dnffryn, Newport, Mon., whose opinion on cattle matters is very valuable, wrote me :—

“I am glad indeed to hear that the Warble raid is progressing so well; everybody seems now to have heard of the pest, and of the simple means of prevention and cure, and those who don't act now, I am afraid won't. Still I suppose we must go on ding, dinging at them.” And this is just what it is. The great cattle owners, heads of Societies, and so on, who have taken up the subject, and through whose observations (and information and courteous permission to make this useful information public) we owe much of the knowledge now spread abroad, are well acquainted with what the attack is and the ease with which it might be got rid of, but with the men who work about the cattle the old stories handed on from generation to generation will remain unless they are driven out by teaching or by showing. We cannot hope to manage this by any other means than what Mr. Stratton well describes as “ding, dinging;” by patient repetition, like blows at the anvil, the matter will be driven into shape, if the leaders will but use their influence, but it should not be forgotten that unavoidable ignorance is one thing, and idleness and deceit another, and that a sweeping statement (where master or buyer knows no better) that the bumps only show a desirable state of affairs is used to hide many a case of sheer neglect and laziness, and to put off many a beast unfairly on an ignorant purchaser.

The great losses both as to health and regarding quality and quantity of milk in dairy farming, loss of flesh on fattening beasts, and deaths from what is shortly termed “rottenness” of the back, and other consequences where Warble holes are many, and the losses on hide, have been gone into in such detail in my preceding reports, it is unnecessary to repeat them, but I give a few notes from the communications of the last season which confirm the previous information, and especially continue to prove the ease with which the attack may be put an end to.

The notes following refer to illness, inflammation, and general non-thriving, being caused by Warble presence.

“Last year about this time, I was called in to a little three-year old heifer whose back was almost covered with Warbles, and the effect on the constitution was very marked; the poor thing was very thin and would not eat. I was satisfied that the irritation set up by the Warbles was the cause, and applied the following :—Turpentine, 1½ oz.;

sulphuric acid, 1 drachm (here a chemical action takes place, and must be done with caution). To this I added 10 ozs. raw linseed oil, and rubbed the cows back once a day with the mixture.*

“In a fortnight the back was cleaned, and all the maggots destroyed.”—HENRY THOMPSON, M.R.C.V.S., Aspatria, near Newcastle, April 11, 1887.

“One of the cows I purchased has 18 large Warbles. The skin all along the back appears hot and inflamed. Sores have also broken out in other parts of the body. I applied the smear myself, and found her very irritable when touched.”—J. A. SMITH, Rise Hall, Akenham, near Ipswich, March 28, 1887.

“I am thoroughly convinced of the great loss occasioned by these pests. I may say that the young cattle going in summer on the mountain pastures are specially infested with them, and the loss from the cattle not thriving as they ought is very serious.”—JAMES McCONECHY, Ardnacross, by Campbeltown, Argyleshire.

May 2nd, Mr. John Saunders, writing from Berniehill Farm, Milnathort, Kinross-shire, requested information as to Warble, and how to cure it. “As I had four very fine stots this winter that were very ill with Warbles, I blame nothing else for keeping them down in condition.”—I. S.

“I am convinced that the Warble-maggot at this time of the year, when cattle owing to the shortness of keep are in many cases weak, are a great hindrance to their thriving.”—EVAN WILLIAMS, Bryndee, Llyswen.

“Local butchers who have killed our cattle that were bad with Warble this spring tell me that their presence involves much greater trouble in skinning and cleaning, but if the cleaning be very carefully done they do not consider that the meat has been injured. . . . I think that the animals killed during April and May, affected with Warbles, brought from ten shillings to one pound less than they would have done if they had been free of this blemish.”—DAVID WILSON, Jun. Carbeth, Killearn.

Benefit of clearing the maggots; various applications found to answer for killing them; summer galloping stopped by destroying the maggots in spring.

In the following notes it will be observed that several kinds of applications have proved serviceable. The point wanted is, that whatever is put on should either stifle the maggot by choking up the breathing-holes, which are placed in the little black spots at the tail

* “The sulphuric acid, turpentine, and raw linseed oil mixture is an old preparation, very old, and is known by the name of Black oils.”—H. T.

of the maggot, seen in the opening of the Warble, or should poison it by the application oozing down to the bottom of the Warble cell, As the maggot lies with the end through which it draws in food downwards, whatever of a poisonous nature that runs down mixes with the fluid or putrid matter, and is necessarily swallowed by the grub.

Of the various applications which are reported, and have been reported for several years, as serviceable for killing the maggots, it appears to me that mercurial ointment is the best adapted to the purpose in hand, as it *both* chokes and poisons the maggots; but it should never be used except as a very small spot placed just on the tail of the maggot in the Warble. It should *never* be used as a smear, nor should the touching be repeated except under special circumstances, or to (say) two or three Warble holes, and it should only be applied by those who can be trusted. Of the other remedies, McDougall's smear has been the most reported as almost unfailing in effect, and squeezing out needs no comment. Where the *animal* can bear it, the *operator*, especially if he is a boy, has such a satisfaction in the demonstrably successful operation that this method needs no recommendation. The use of Calvert's carbolic soap, tar, brimstone, and various other applications will be found mentioned below, to which I will add cart-grease, or bad butter, or lard mixed with sulphur, which has been found to be an extremely good application.

Benefit from destroying Warble-maggots.

"I think I told you that the herd as far as they have been reared on this farm, where I have prevented the grubs from developing into flies, is quite free from Warble."—March 28th. . . . : "In exterminating the Warbles on purchased cows in June I used the 'Smear,' also Bowden's Hippacæ, (Indian preparation), and also salt and water. The former two were effectual, but the salt and water appeared useless and difficult to apply in the holes caused by the Warbles. I am now using McDougall's dressing, as a wash to keep all flies off my cows, with good effect."—J. A. SMITH, Hon. Secretary, East Suffolk Chamber of Agriculture.

"On our own farm we have strictly followed the directions, and killed every maggot, and also smeared the backs of the cattle, with most beneficial results. In our stock, which formerly used, (as the men say) to *boil* with these maggots, not one is to be found now, but nearly every beast we buy has them."—The Hon. CECIL PARKER, Eaton Estate Office, Eccleston, Cheshire.

"This pest, I am very sorry to say, is very prevalent in this neighbourhood. I do my best by the application of mercurial ointment to keep them down in my own herd, but as my neighbours do

nothing the pests always appear with the spring."—R. BASSET, Highclere, Newbury.

"We have a large dairy, and last year found a great number of maggots. We used mercurial ointment as you advised, and got out a great number."—Miss MARGARET CURTIS HAYWARD, Quedgeley, near Gloucester.

"I have sixty bullocks now fattening in covered yards. I believe that every one has Warbles more or less. I have had them dressed with mercurial ointment, and I believe all the grubs are killed."—K. M. COURTAULD, Cut Hedges, Halstead, Essex.

"We have not examined all the stock , but as far as I have been able to examine the cattle I have not found one [Warble]. We used powdered brimstone as being least likely to taint the milk."—DAVID BYRD, Bnnbury Heath, Tarporley, Cheshire, April 2, 1887.

"Our twenty-five cows are at present free from Warbles, thanks to your exertions. Last two winters we put a spot of tar on each opening,—but of course our neighbours grow plenty,—and I think the immunity is due to washing the backs of the animals, last summer several times with tar-water."—J. A. CHAPMAN, M.D., Bury Hill, Hereford, March 28, 1887.

"From another tenant I elicited that living in an isolated farm, where there was no sale for buttermilk (or 'churn' milk, as we northerners term it), he used the same as a wash for his cattle three or four times in the season, which kept them remarkably free from the pest; and another treats his stock with strong brine, and with similar results."—F. C. SMITH, Westgate Road, Newcastle-on-Tyne.

Good effect of dressings, and also of previous removal of the maggot, in preventing summer disturbance.

"I should have written you before as to the effect of dressing for fly, but thought I would wait and make quite sure as to the results. I prepared mixture as you recommended, *id est*, 4 oz. flower of sulphur, 1 gill spirits of tar, and 1 quart of train-oil, and applied the same to 16 beasts. The effect was very marked; previously they had been galloping about all the day, continually getting out of the field and giving much trouble thereby, since not one of them has got out, and the men who were making hay in adjoining fields, and had full opportunity of watching them, tell me that *since being dressed they have scarcely run about all*. I have since applied the same mixture to the whole of the beasts on my farm, and am so well satisfied with this application that I have not tried either of the other receipts."—H. J. HILLARD, Helland, North Curry, Taunton.

"At the beginning of the spring of 1886 I saw a note in one of our local papers from you, calling the attention of owners of cattle

to the Warble-fly. I set about to dress them with mercurial ointment, and it had the desired effect; they were very little disturbed all the summer, but it was more noticeable at the beginning of this year to see how clean and nice the backs of the cattle were, only two or three that had any upon them. The young cattle, (I mean the one year old and two years old) were not dressed, as I did not consider they needed it, mostly being only one year old this spring. I found several of them had a good many. I have dressed all or nearly all a second time to-day. I am glad to say my cattle have to my knowledge only once been disturbed through this very hot weather. I have dressed this year with sulphur and train-oil, which I see you recommended."—W. DAVIDSON, Lower Green, Acton, Northwich.

"We followed the directions given with the most satisfactory results. During all the trying weather of the past month our cattle have been quite comfortable and comparatively free from insects of all kinds, forming a happy contrast to their condition in previous summers."—Mrs. HIGGS, Westons Rusper, near Horsham.

"For many years I have used a weak solution of McDougall's sheep-dip, and have found it keep my grazing cattle perfectly quiet in the hottest day. We drive the cattle to a corner and keep them jammed close together by the dog, whilst the man sprinkles them with a common garden watering-pot with a rose on the spout. This is done every week, if the weather is wet, otherwise about every ten days."—H. LINDSAY CARNEGIE, Kinblethmont, Arbroath, Nov. 13.

Mrs. Holford, wrote from Castle Hill, Berne, Dorchester:—"I have found well washing my cattle in the spring with Calvert's carbolic soap, kills all the maggots; we wash them thrice at a fortnight's interval. Carefully following your directions as to dressing for the fly has given our cattle a quiet summer."

Capture of the Warble Fly amongst tethered cattle.

The Warble-fly itself is seldom captured, but I was fortunate enough last summer to have two specimens sent to me by Mr. W. S. Richards, of Rathturret, Warrenpoint, Co. Down, Ireland. The first was forwarded on the 30th of June, with the observation:—"It seems that when the cattle hear it in the air they are off. It does not seem to do more than rest on the cattle for less than a second. My cows are docile; I can stand near them and watch. Bees of different kinds they took no notice of, but knew the hum of this insect." On the 17th of August Mr. Richards sent me the second very beautiful specimen, which was quite soft and uninjured when I received it. From the downy appearance the insect looked exceedingly like a good-sized bee (only with one instead of two pairs of wings), and the black band across the body between the wings, with a yellowish band before

it, also the blackish band across the abdomen, and orange colour at the tip showed well. Mr. Richards wrote accompanying, after alluding to my previous letter on Ox Warble Fly. "We have been since trying to catch some more, and, though we had several chases, only were able to get one this morning. This one flew at the legs and flanks of a young Guernsey bull, "he broke tether and came home, the fly still at him; we got them both." "I have never known the flies later than the 2nd or 3rd of August in other years; all my cattle are on tethers, and house-fed by day in hot weather, excepting six before mentioned, (referred to in Mr. Richards letter) which I had no room for and could not then sell. This causes us to watch dates very closely."

The above note is of special interest in connection with the remark of Mr. W. H. Liddell, given in 8th Report, p. 106. "*And why are bulls so very subject to them?* Because they are often fastened, and have no means of clearing themselves of the fly when grazing, and in winter tied up without any attention paid to the state of the backs." It is worth remark, that where the cattle were from necessary circumstances more exposed to attack, the fly was so much more noticeable as to allow having several chases and two captures, and also that the few cattle that were free were so maddened by the fly as to leap a parapet wall for the purpose of getting into water, and continued swimming about in a reservoir nine feet deep, with their own good will, to avoid attack.

The following account is well worth study, as showing what can be done by quiet, unobtrusive, but thorough work in clearing out Warbles from a district. Mr. W. Bailey, the Head Master of Aldersey Grammar School, Tarporley, Cheshire, has now for several years instructed such of his pupils as were desirous to learn in the history, and best methods of destruction of the common farm insects, with such great success that the Consulting Entomologist of the Dominion of Canada, wrote over to enquire into the method pursued. The pupils are for the most part sons of farmers and farm labourers, and the instruction is voluntary. Mr. Bailey gives his exceedingly serviceable teaching, and such boys as desire may have the benefit of it, and we (I may say as I have the pleasure of co-operating to some small extent) have *no examinations*. The knowledge received is shown by results seen on their fathers' farms, and not merely heard by word in examination. With regard to the Warbles the boys were first shown the maggots and told their history, and desired to bring what they could find, and in 1885 one pupil, Frank Ravenscroft, brought 250, and in 1886, the following year, when he examined 114 head of stock belonging to his father and brother, *he found no Warbles*, excepting on the young stock, which had not been dressed, because they were out in the fields.

The work progressed very favourably, and on March 28th of last year Mr. Bailey wrote me that he had desired some of his pupils to examine their cattle, and report results, and he forwarded the following table.

In nearly all the cases in which Warbles were found, including the entry of 50 Warbles on 20 cows, the Warbles were on stock recently bought in, not on cattle which had been examined.

I give the list as sent, with the names of the boys, as they have done good work, and kept it up, and it may encourage others. It will be seen the stock vary in number, from one cow of a cottager, up to the farmer's large herd of fifty-seven.

Aldersey Grammar School, Bunbury, Tarporley, Cheshire.

OX WARBLES.

NAME.	STOCK EXAMINED.	NUMBER OF WARBLES FOUND.
Percy Willis	20 cows & 20 year- ling calves	3 warbles in cow lately bought
Edgar Willis	40 cows & 3 heifers	Only 2 warbles
Charles Palin	24 cows & 1 bull	1 warble in bull and 1 in cow
Alick Dale	57 cows	17 warbles in newly bought cows, none in last yrs. stock
John Whittle	42 cows	7 warbles in cow bought, none in others
Thomas Willis	1 cow	1 warble
Joseph E. Dutton	2 cows and 2 calves	None
Herbert Stockton	1 heifer and 1 cow	4 warbles in heifer
James Williamson	2 cows	None
Thomas Whittle	6 cows and 2 heifers	10 warbles in heifer
William Cookson	1 cow and 1 heifer	None
Thomas Jones	20 cows	50 warbles, 20 in 1 cow, re- mainder in 5 cows
John Kirkham	3 cows and 1 heifer	None
Joseph Proctor	4 cows, 1 heifer and 1 calf	1 warble in calf
George Garnett	10 cows and 2 bulls	3 warbles in one bull
Henry Garner	2 cows and 1 heifer	4 warbles, 3 in cow and 1 in heifer
Thomas E. Willis	10 cows	None
Arthur Jones	2 cows	None
Herbert Mitchell	10 cows	None

Number of Stock examined,
293

Number of Warbles found,
104

WM. BAILEY,
Head Master.

March 28th, 1887.

On April 13th, 1887, Mr. Bailey further informed me :—" Another lot of boys have examined and reported to me on 250 head of stock. The results agree with those I sent you."

" Where the cattle were properly attended to last year by the Warble maggots being squeezed out, or dressed with McDougall's smear or cart-grease, there are scarcely any maggots to be seen now ; where, however, this precaution has not been taken, the enemy is to be found in full force.

" As examples of the former I may mention two of our boys, Henry Milling and Percy Attwood, who paid great attention to the stock in this matter last year.

" Last week Milling examined 48 cows and 10 heifers, and *found only one Warble* ; Attwood examined 53 cows and heifers, and *found only six*.

" On the other side, where remedies had not been applied, " two brothers removed 40 maggots this week from one stock, and their task is not half done ; another boy applied McDougall's smear to 70 Warble-maggots.

" It is not only on our large farms where so much energy is being shown in an effort to stamp out this pest, but the sons of our cottagers are equally active in the cause. These boys in a few years will be our agricultural labourers, and I encourage them to examine and report to me on their one cow and heifer.

" The boys in the lower part of the school are doing what they can. On Thursday, one little fellow only ten years old brought me eight maggots which he had squeezed out of the calves.

" Where the stock is free from the pest the boys tell me, " the cows are milking unusually well this year." " *I have no hesitation in saying that in this parish alone what has been done at your suggestion has put many pounds into our farmers' pockets, for their stocks are giving more milk, and are feeding better. The hides also are worth more money.*"

I have given the above at length as the work being done under the eyes of Mr. Bailey, and likewise of Mr. D. Byrd, of Bunbury Heath, and many of the other farmers of the neighbourhood, it is no mere fancy or half-proved experiment, but what could be judged of by all connected with the stock in the district, and it shows not only the benefit of getting rid of Warble-grubs, and the thoroughness with which they can be cleared out of a district, but the benefit of plain common sense instruction on the subject of farm insect pests.

The last year's work has done much towards undermining the hold of this pest, and I therefore add the chief part of my four-page leaflet (6th edition). which was distributed largely last year. (Should any interested in the subject desire copies for themselves, or for distribution in the coming season, I would forward with pleasure on application) :—

NOTES on OX WARBLE FLY or BOT FLY
(*Hypoderma Bovis*, De Geer.)



1, OX WARBLE FLY ; 2, maggot ; 3, chrysalis.

THE OX WARBLE FLY, or BOT FLY, is a two-winged fly, upwards of half an inch in length, so banded and marked with differently coloured hair as to be not unlike a Humble Bee. The face is yellowish ; the body between the wings yellowish before and black behind : and the abdomen whitish at the base, black in the middle, and orange at the tip. The head is large ; the wings brown ; and the legs black or pitchy, with lighter feet.

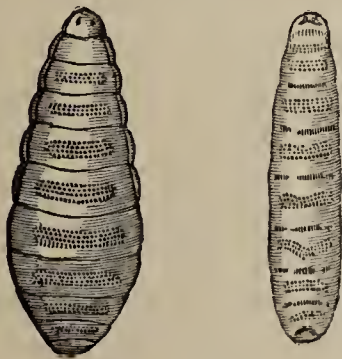
The female is furnished with a long egg-laying tube ; but whether she inserts her eggs into the hide or lays them on it has not been made out with certainty.

Egg-laying takes place *during the summer* ; it may begin in the month of May, but the time varies with the weather, and with the cattle being on low land or hill pastures, and other circumstances. The egg is oval and white, with a small brownish lump at one end.

When full grown the Warble-maggot is the shape figured above.

The mischief may first be found on the flesh side of the hide early in the winter. Specimens received from Messrs. Hatton, Hereford, on November 13th, showed the first appearance as small swellings bluish in colour, as if half a large shot was under the skin, and much inflamed round. The maggots were very minute and blood colour, and lying free (not in a cell) with a fine channel down through the hide to where they lay.

The open Warble was first found towards the end of January, and by the end of February open Warbles were noticeable in many places, and the maggot was now white (not being feeding in bloody matter), worm-like, and with strong mouth-forks ; in its next stage it was club-shaped, and had a power of inflating itself by drawing in fluid until



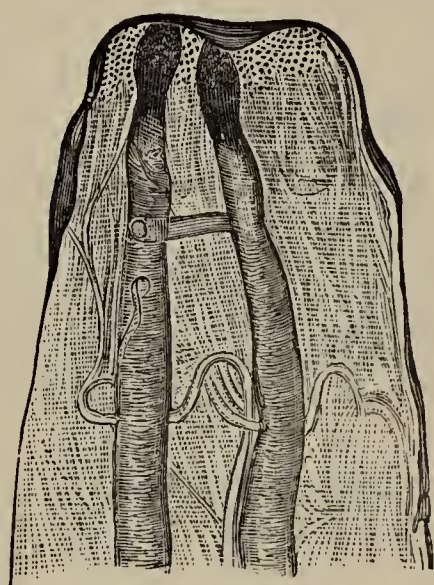
Maggots.
Club-shaped. Worm-like.
Magnified.

it was almost as hard and transparent as ice, and, lying small end uppermost, thus kept pressing the opening through the hide larger. In its next stage it gained its well-known shape, with a thicker and more prickly skin, the Warble cell at the same time gaining its membranous coating.

The maggot can move up and down, but commonly has its brownish-tipped tail at the opening, and it draws in air



Mouth-forks of young maggot,
much magnified.



Breathing-tubes of maggot,
magnified.

through breathing-pores in these brown-black tips or spiracles. The mouth-end is down below feeding in the ulcerated matter caused by irritation from perpetual suction of the mouth parts. The maggot cannot protect itself from the effect of applications, therefore anything put on the opening where the breathing tips show will choke the breathing apparatus, or run down into the hole and poison the maggot. The earlier this is done in the season the better it will be for the animal, and the less difficulty there will be in the Warble holes healing.

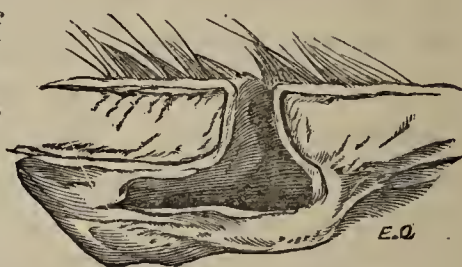
Whilst the maggots are in the Warbles, though a skin-like membrane forms round the surface of the perforations (see figure below), they cannot heal up because the maggot lies within, and when the warble-grub has *fallen out*, though the whole contracts, the surfaces being already covered with a film of tissue are slow to unite; and, as may be seen in warbled hides, union is often prevented by this skin-like film shelling off, and laying with dried matter in the perforation. On the under side of the hide, though the *surface may*

not be broken, yet the subcutaneous tissues are often left as a mere film of no strength, which injures the surface of the leather.

When the maggot is full grown it is about an inch long and dark grey; it presses itself out of the opening *tail foremost* and falls to the ground, where it finds some shelter, either in the ground or under a stone or clod, where it changes to a chrysalis. The chrysalis is dark brown or black, much like the maggot in shape, only flatter on one side; and from this brown husk the Warble Fly comes out in three or four weeks, but this length of time is *increased by cold weather*.

With regard to methods of remedy, there does not appear to be any difficulty of getting rid of the Warble-maggot easily and cheaply, when the Warble has "ripened," that is, opened so far that the black end of the tail is visible. *Then* it may be destroyed cheaply and quickly. From special observations, taken during the last two years, it has been found that where the Warble-maggots have been destroyed before they drop from the cattle there is little if any summer attack of Warble-flies. Consequently the cattle can rest in peace, and, as there is very little egg-laying on them, there are scarcely any Warbles in the following spring.

Squeezing out the maggots is a sure method of getting rid of them, but they may be destroyed easily and without risk by dressing the



Section of Warble, after
soaking in water.

Warble with a little McDougall's smear or dip, or by a little cart-grease and sulphur, applied well on the opening of the Warble. Mercurial ointment answers, if carefully used, that is, in very small quantity, and only applied *once* as a *small* touch on the Warble; but where there is any risk of careless application it should not be used. Any thick greasy matter that will choke the breathing-pores of the maggot, or poison it by running down into the cell in which it lies and feeds, will answer well; and lard or rancid butter mixed with a little sulphur has also been found to answer. Tar answers if carefully placed, so as to be absolutely on the hole into the Warble. Bought cattle are often badly infested, and need attention.

To prevent fly attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce.

A mixture of spirit of tar, linseed oil, sulphur, and carbolic acid, has also been found useful, and anything of a tarry nature is useful, as sheep salve (or bad butter and tar mixed with sulphur), or Stockholm or green tar rubbed on the top of the cows' backs between the top of the shoulder-blade and loins. Washes of a strong pickling brine applied two or three times during the season are very useful. Paraffin and kerosine are useful for a time, but the smell goes off before very long.

Warble attack is one of the few in which each owner benefits surely by his own work.

The attack of Warbles is now grown to be one causing enormous annual national loss, estimated by practical men at sums from *two millions to seven millions pounds sterling per annum*, at the least, and there is no sort of reason why we should suffer it to go on. Any applications to myself on the subject will receive immediate and most careful attention, and any information would be gladly received.

ELEANOR A. ORMEROD,

*Consulting Entomologist
to the Royal Agricultural Society.*

Horse Warble.

Various notes have again been sent of observation of Warble in horses, showing that the attack is not uncommon, and is also apt to be very troublesome when the swelling is under the saddle. No advance, however, has been made towards finding whether the fly that causes the mischief is the Ox Warble Fly (the *Hypoderma bovis*) or another species. It has not therefore appeared worth while merely to give notes of observation. The remedies are the same as with Ox Warble.

Ox Gad Fly. *Tabanus bovinus*, L.

TABANUS BOVINUS.

OX GAD FLY, with side view showing proboscis.

The attack of the great Ox Gad Fly, the *Tabanus bovinus*, is often confused (by name at least) with that of the Ox Warble Fly, and though this Gad Fly is not common with us as it is on the Continent of Europe, during the last season I received some small amount of communication regarding it from various quarters.

This "Gad Fly," which is figured above, may be very easily known from the Ox Warble Fly, by being a great deal larger. It (the Gad Fly) is little less than an inch in the length of its body, and from about, or over, an inch and a half to two inches in the spread of the wings. One of my own specimens is of quite the largest measurement mentioned above.

The fly is mostly brown, and bees'-wax colour. The part of the face beneath the great eyes is yellowish; the upper part of the body between the two wings is brown more or less striped with greyish or yellowish hairs, and the abdomen is very handsomely banded across, with alternate brown and somewhat tawny yellow, the yellowish bands being on the hinder borders of the segments, whilst down the middle of the back—that is down the centre of the abdomen—runs a row of triangular white spots. The under side of the insect is chiefly yellowish or yellowish grey. The legs are dark tawny, or brown with yellow shanks, and the two wings are pale grey, with tawny colour at the base and along the fore edge.

The rich dark colouring and the great size, make the Ox Gad Fly very easily distinguishable, but the chief peculiarity is in the form of

the mouth parts of the female, which are especially adapted for blood-sucking. By the means of the sharp knife or lancet-like apparatus enclosed in the proboscis, the female can pierce into the hide of the animal and suck the blood; and this apparatus, which is very plainly to be seen, is another distinction between this Gad Fly and the Ox Warble Fly, which has nothing that can be called a feeding mouth.

This Gad Fly is not, as far as I am aware, at all common in England, but now and then an enquiry or a specimen is sent, and last year one was forwarded to me on the 26th August, by Mr. James Carter, of Burton House, Masham, Yorks., with the observation that this large insect was occasionally found in the neighbourhood.

I had also a note regarding Gad Fly from Miss Fleming, Monasterevan, Co. Kildare, Ireland, describing the buzz of this great fly, a kind of heavy droning intense noise, easily known when it has once been heard. This loud hum is mentioned by various writers as terrifying to cattle.

The maggot, which is not unlike that of Daddy Longlegs, lives in the earth (*not* in the hides of cattle). It is somewhat cylindrical in shape, smallest at the extremities, or more especially in front, greyish white in colour, and somewhat darker at the divisions of the segments; legless; and has a shining brown elongated head, furnished with two strong jaws or curved hooks, and has a fleshy protuberance at the end of the tail. The grubs are stated to be found in meadow land, and more especially in wood land.

“ Their development and pupation take place similarly to that of the Daddy Longlegs.”*

The pupa or chrysalis is long and somewhat cylindrical, with six spines at the end of the tail; but as description does not very well convey a precise idea of the appearance of different states of insects, I add a figure of an American kind of Gad Fly, in its three stages, by Prof. Riley, who kindly allows me to make use of it.

The life history of this genus of flies (the Tabani) has not as far as I am aware been yet recorded from observations made in Britain, but it is given by Dr. J. R. Schiner, as follows, in Germany:—

“ The grubs live in damp earth or sand, or under decaying leaves and stems in damp places.

“ The flies are often to be found in cattle pastures, and by roads and paths, where they rest on the stems of trees, waiting for the

* I have not had any opportunity myself of seeing these flies in their maggot or chrysalis state, therefore I give the description of the maggot mainly from the well-known observations of De Geer, and regarding habits mainly from comparison of information given in ‘Fauna Austriaca,’ ‘Die Fliegen,’ J. R. Schiner, ‘Praktische Insekten Kunde,’ E. L. Taschenberg, and ‘Introd. to Classification of Insects,’ J. O. Westwood.

cattle or horses, to which the blood-sucking females are very troublesome. The male flies frequent flowers, or hover over roads, especially in the morning and evening.”*



TABANUS ATRATUS, FAB.

Black American Gad Fly, maggot, and chrysalis, after Riley.

Should these flies be troublesome it would seem—looking at their great size, which makes them very conspicuous; and their loud hum, which draws attention to their presence; and also considering their habit of circling round the animal before striking for blood-sucking—that an active boy might secure the fly with a common long-handled insect net when on the wing, or with finger and thumb on the animal; but I have mainly mentioned this attack to show how completely different the Ox Gad Fly is in size and appearance, in condition in every state, and in habit, from the excessively injurious cattte pest the Ox Warble Fly.

* See ‘Die Fliegen,’ by J. R. Schiner, previously quoted.

S H E E P .

Maggot of Sheep Nostril Fly. *Æstrus ovis*, Linn.



ÆSTRUS OVIS.

Fly, magnified, with line showing natural length, maggots, mouth-hooks of maggot, and tail segment, showing spiracles, and lobes acting as organs of progression, all magnified, after Brauer, see p. 125.

For some years back I have from time to time received specimens of Sheeps' Nostril-maggots, with various enquiries regarding them, and occasionally a statement that the maggots forwarded were found "in the brain," or "at the base of the brain," as the case might be. This circumstance seemed very unlikely, nevertheless it appeared worth investigating, as I was personally aware that in a locality near London the usual buyers of Sheeps' heads did not like to purchase them about May, because of the presence of the maggots (which were certainly there), and which I was informed they considered were in the brain; also the presence of these maggots in the brain has been mentioned in more than one entomological work, and was alluded to by Prof. Riley as being considered possible, according to the evidence of some practical Sheepmen, by means of these larvæ making their way through the perforations of the ethmoid bone; of course in this case the creature would not get in when it was a thick lumpy maggot, about an inch long, but (that is if it did it at all) in its first stage, answering to the fine worm-like form in which the Ox Warble-maggot cuts and pierces its way down through the thick hide of the attacked cattle, to the under or fleshy side.

During last summer I bestowed the best attention I could in examination of Sheeps' heads affected by staggers or "gid," conjectured to be caused by Nostril-maggot, and also of the state of those with maggot in the nostrils, and can certainly say that there did not seem the slightest reason to suppose that the maggots entered the brain, or had anything to do with attack of "gid," of which the common cause is well known; but at the same time there is no reason why a sheep should not suffer, both from hydatid in the brain causing the gid, and presence of the maggot in the nostrils, at one and the

same period, and when a number of maggots, up to over an inch in length, have forced themselves not only into the nostrils, but as far as they can go into the cavities above, the symptoms of discomfort or serious suffering in the front of the head may very likely agree in some respects with those of gid.

The method of attack of the Nostril-maggot Fly consists in laying her eggs, or living maggots as the case may be, in (or by the opening of) the nostrils of the sheep.

These maggots work their way up the nostrils by means of a pair of hooks with which they are furnished, which are placed near the mouth opening, and also (I should say from watching their method of progression) by help of a pair of tubercles placed at the tail with which they can push themselves forward, as well as by the adhesion of the under side of the maggot to the coating of the nostrils. The maggots grow to be from rather under to rather over an inch in length, and of the thick somewhat oval shape figured (p. 121), and white when young, afterwards with dark or yellowish cross-bands. The brown breathing pores or spiracles, like those of the Ox Warble grub, are at the end of the tail, but are somewhat differently shaped.

The maggots feed in the nostrils, or high up in the frontal cavities, and are especially to be noticed about May or June. They are said to feed in the nostrils for a year; when full-fed they fall out of the nose, or may sometimes be sneezed out, and make their way into the surface of the ground in a short time (considered to be from twenty-four hours to two or three days), where they turn to a brown chrysalis, from which the fly comes out in about six or eight weeks.

This two-winged fly (figured magnified) is mottled light and dark over the back, and the precise shades of tint variously described by various writers. From comparison of my own with descriptions I should say that it might be called spotted or mottled with ash grey and black between the wings, and the abdomen also spotted with black and yellowish white, with a silvery lustre when alive; wings colourless and transparent; legs yellowish brown.

Amongst the heads which were sent me for examination, and carefully opened, we found some of sheep which had been ill of the staggers, or what was thought bad attack of "giddiness," had the cyst in the brain, of which the following figure, copied from one given by Dr. Cobbold in his 'Internal Parasites of our Domesticated Animals,' gives an idea; but we could not find any trace of maggot presence either in the brain or nostrils of these, and where I found maggots they were quite in the part of the nostrils or passages external to the brain.

The various specimens of maggots sent me afforded excellent opportunity for investigations of structure, and showed this to be

thoroughly suited both for progression up the nostrils and hanging on to the coating, and also for keeping their breathing-pores safe from being choked by moisture, but by no means suited for living in the brain.



Upper surface of the brain showing an hydatid.*

The form and very special apparatus of the head and tail are adapted for movement and for holding on,—*not for lying in a surrounding soft substance*. Likewise the maggot possesses a breathing apparatus of spiracles so placed at the end of the tail that under special circumstances, and at the will of the maggot, these spiracles may be protected by the upper rim of the end segment in which they are placed being drawn down over them, so as to meet the projecting lobe below, and thus by closing over them (much like the lips over the teeth) preserve these breathing-pores from being choked up by any special flow of fluid matter down the nose. This apparatus has an obvious use in the nostrils, but in the brain the maggot would be so closed in by surrounding matter that the air would have no access to the breathing apparatus whether open or shut. As these maggots live in maggot state for about a year,—and (*supposing them to live in the brain at all*) almost the whole of their year's life would have to be passed in it, because they *could* only pass in whilst still in most

* For the history of the *Cœnurus cerebralis* or Hydatid, which in its young state causes “gid” in sheep, and subsequently develops to tapeworm in the bowels of the dog, in cases where the dog has fed on the uncooked infested brain, the reader is referred to information given in Chapters vii. and x. of ‘The Internal Parasites of our Domesticated Animals,’ by Dr. Cobbold, where some very plain and serviceable remarks are added as to the part played by dogs in distributing the eggs of the tapeworm so as to start new attack in the flock. I have also especially to acknowledge the kind assistance given me by Mr. H. Bullock, F.R.C.S., of Spring Grove near Isleworth, in helping me to make a careful examination of the first hydatid infested head, which otherwise I could not have fully studied.

minute condition; it appears that the existence of this breathing apparatus quite disproves their presence in the brain, for in it the breathing-pores would be as thoroughly choked up, and the maggot destroyed, as when in the Ox Warble-maggot the pores are choked with cart-grease or any other thick permanent application.

The following are a few details from examination of Sheep-nostril maggots:—

In some specimens sent me from Maulden, Ampthill, Beds., I found the maggot to be arched above, flattened beneath, increasing in size towards the head end. This head segment was much the smallest of all, and furnished with a pair of thick fleshy antennæ placed above, and on each side of, the notch answering to a mouth. From this a pair of strong black curved mouth-hooks were frequently protruded and withdrawn, whilst I held the maggot in my fingers. These appear to be suited to act not only as hooks to drag with, but also as flat nippers or pincers, to pinch up any soft matter that lay between them, and further, at the base of each of these somewhat sickle like hooks, there was a kind of horny tubercle which would give additional help towards dragging the maggot onward.

Beneath, it was furnished with ten narrow cross bands of prickles, the band nearest the head being the smallest.

The tail segment was rounded with a slightly swollen border, and in the centre of the upper part are the dark brown spiracle plates, or breathing-pores, of a shape which might be called triangular, with the angles very much rounded or five-cornered (see fig.), the two sides of the pair of plates opposite to each other being the longest, and in the centre of each spiracle was a raised brown spot.

Beneath the spiracles at the caudal extremity of the larva was such an enlargement that the lower part of the segment projected markedly, forming a central lobe turning up towards the spiracles and bearing a small patch of prickles, on its upper surface (see fig). Also it was furnished on each side with a fleshy process or tubercle (see fig., p. 121) apparently very useful in progression.

The power of rapid movement was very remarkable. On placing one of the Nostril maggots on a cloth it moved onwards, at the rate of $3\frac{1}{2}$ inches in the first minute, and $4\frac{1}{2}$ in the second, and when the maggot was placed on the hand the movement could be seen to be helped both by head and tail. The black mouth-hooks were almost fixed into the skin of the hand, pressed so firmly that the pressure could be felt, and thus served as a power by which the maggot kept itself in place, whilst the lobe of the tail with its pair of pseudo-feet served to propel the soft body on from the tail end, the maggot thus being able to get on at a fair pace by alternately fixing and shoving. When placed on glass the maggot had a power of moving by simple

adhesion of its own lower surface, to the smooth surface of the glass.

With a view to learn what might happen when the maggots had the opportunity of entering the brain, I placed two on the brain of a recently killed sheep, and watched operations. One maggot gradually disappeared from sight, amongst the folds of the brain; for some time it appeared (when I turned back a fold) to be moist and inflated, but presently died. The other remained outside, and though from the colour of the contents it was obvious it imbibed the blood or coloured fluid in which it was lying, this specimen died also. It was not likely that in any case the maggots should live on putrescent matter, but the above experiment at least showed that when there was every need for them to find congenial shelter, that though one buried itself in the folds of the quite fresh brain, neither of them made entrance into the substance.

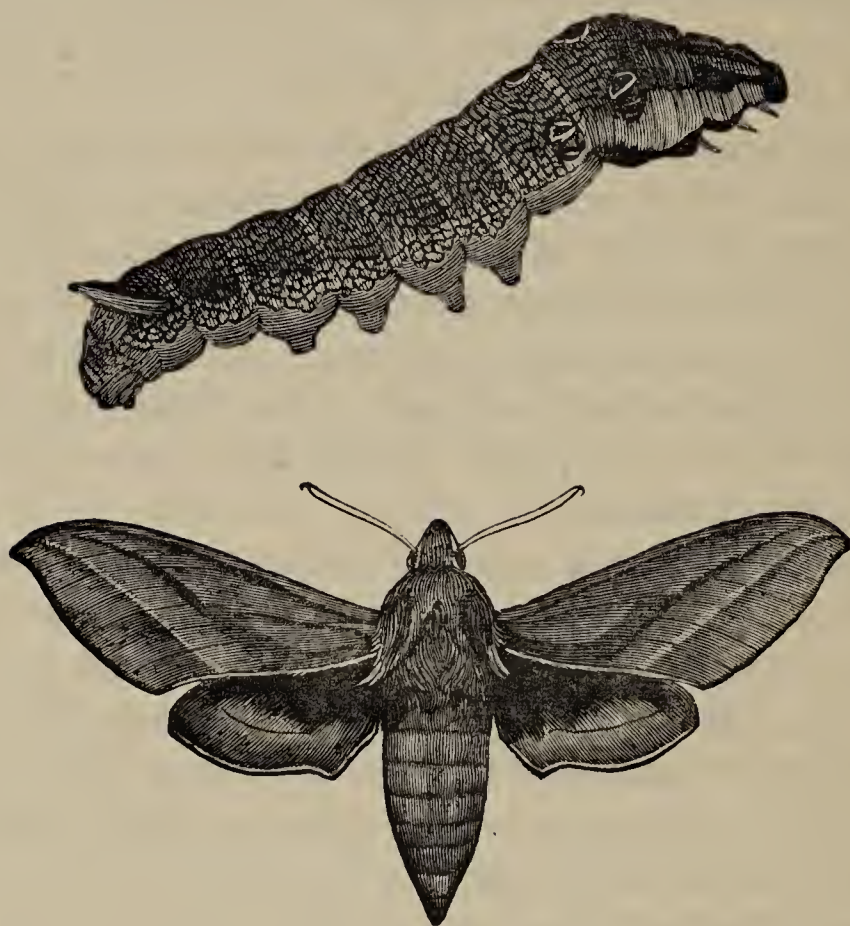
It may be thought that entering on the above matter of possible brain presence is quite unnecessary, but from the popular views which are held in some localities, and the doubts which have been expressed, or statements made in various entomological works, it has seemed desirable to endeavour to say something on the subject.

I have little personal knowledge of the attack in its really important aspect as injurious to the flock in the field, and as this comes under regular veterinary treatment need not enter on this part. But it could not fail to be of service when the flies are tormenting the sheep, which may be known by the sheep putting their heads down to the ground, and stamping with their fore-feet as if to drive off the attack, to move them if possible to fresh pastures, where the flies were not coming out of chrysalids from maggots lately dropped from the noses of the sheep, and also to adopt the common practice of tarring near the opening of the nostril, or to use any other possibly more serviceable application, so as to deter the fly from passing in to lay eggs, or to prevent any maggots which may have been deposited alive or hatched out, from crawling into the nostrils and establishing themselves within.

I beg to acknowledge the figures of the fly, &c., of the *Æstrus ovis*, L., at p. 125, as being copied from the beautiful illustrations given by Dr. Friedrich Brauer in Plates III. and VII. of his 'Monographie der Æstriden.'

“MURRAIN WORM.”

Caterpillar of *Chærocampa Elpenor*, Westwood.



ELEPHANT HAWK MOTH AND CATERPILLAR.*

The caterpillar of the Elephant Hawk Moth, which is figured above, is by no means given as an injurious insect, as its food is of Willow Herb and Ladies' Bedstraw, or on Vine, if the caterpillar chances to be in a garden. But from its extraordinary and repulsive appearance it is often looked on with alarm, and at least in one district in Ireland as the cause of murrain in cattle, and therefore deserves a note to mention its harmlessness.

In the course of last year Miss Fleming, writing from Derry Lea, Monasterevan, Co. Kildare, Ireland, mentioned:—"There is a very large caterpillar sometimes found here (I have seen it four inches long) which is said by popular voice to give the disease called 'murrain' when licked or swallowed by a cow.

"The people call this creeping thing a Murrain Worm The last I saw was on the approach, travelling as if it was running for its life, about five years ago."

On the 7th of August Miss Fleming forwarded me a specimen of this

* The figure of the caterpillar is taken from one of the three beautiful drawings by the late W. Buckler, given in Plate xxv., vol. ii., of 'Larvæ of British Butterflies and Moths,' published by the Ray Society in 1887.

so-called Murrain Worm, which turned out to be the caterpillar of the Elephant Hawk Moth.

On the 20th of August another specimen of the same kind of caterpillar, which was beginning to spin itself up in a light web, was sent me by Mr. N. Richardson, from the Estate Office, Castle Comer, Co. Kilkenny, Ireland. This had been found in a neighbouring garden. The above figure of the caterpillar gives a very good idea of its strange shape, showing the thick strong appearance tapering rapidly to the small head from the great puffed-out segments into which the head can be withdrawn. The name of *Charocampa* is (as is noticed by Prof. Westwood in his 'British Moths,' vol. i.) derived from two Greek words signifying "hog" and "caterpillar," alluding to the peculiar form, much like a pig's head, of the fore part of the caterpillars. They are found of two colours; one with a ground colour of dull green, with a black-brown freckling of network and blotches, and a spot or blotch on the fourth and fifth segments from the head; the other is brown, marked with blackish network of freckles and variously marked with yellow, besides the eye-like or kidney-like patches on the fourth and fifth segments. Prof. Westwood mentions that the caterpillar is green at first and becomes of the brown, or brown varied with yellow colour, with a dark stripe down the back after the second moult.

Both the specimens sent me were at the brown stage. The caterpillar is stated to spin a cocoon of open net on the surface of the ground, or amongst bits of leaves or odds and ends, in which it turns to a brownish chrysalis marked with black.

The moth has the body between the wings, and abdomen olive-coloured, the first with four pink lines, the latter with three broader stripes running lengthwise; the fore wings olive, with transverse bands of pink; the hind wings of a deeper purplish pink with base and fore-edge of a blackish tint. The mixture of delicate colours intermingled with pure white fringe to the hinder wing, and a white stripe on each side of the body between the fore wings, make the moth as beautiful as the caterpillar is repulsive in appearance. It is rather common, especially in the South of England, and the above short note is only given relatively to the evil effects sometimes, though very wrongly, ascribed to the ugly grub.

APPENDIX.

R U S S I A N S T R A W.

IN the foregoing report, at pp. 44, 45, in the paper on Hessian Fly, notes are given regarding the watch kept for several months during 1887 on imported straw at various seaports on the eastern coast of England and Scotland, with the result of only finding one *puparium*, or "flaxseed," which was attached to a straw grown in Belgium. Later on, that is during November and December, Mr. Edmund Riley, of the Weir, Hessle, near Hull, who had spent much time and pains on this investigation, had the opportunity of examining straw sent from various parts of Russia as packing material for the large amount of eggs then being imported. No Hessian Fly flaxseeds were found, and it will be noticed from the following details that from the method of treatment of the straw it is very unlikely that infestation can take place from this source, as the straw was found to be cut high, above where the flaxseed usually is ; also it was thoroughly bruised to render it soft for proper packing-material for the eggs ; and, further, a large proportion was dried on racks in heated chambers, as it is requisite for proper transmission of eggs from long distances that they should be packed in quite dry material.

The knowledge of these points is of practical service, as it will be observed that the large import of eggs necessarily brings much straw with it.

On Nov. 12th (1887) Mr. Edmund Riley wrote me from Hessle, near Hull, that in the Report of Imports into Hull, for the week ending Nov. 5th, it was stated that "there was the largest importation of eggs in one week ever reported, and chiefly from Russian ports. One vessel had 60 tons ; another 46 tons ; and the 'Cato' had 823 cases, each case containing some thousands." On examination Mr. Riley found the eggs "came in long cases, a pretty thick layer of straw at the top and bottom and a layer of straw between each layer of eggs."

On the 21st of the same month Mr. Riley continued :—"During the week I got several lots of straw from the top of the egg crates, but found they had all been cut off above the second joint. On Saturday I went to one of the large importers (Wood Brothers, High Street, Hull) and I found him, like Mr. Halls, ready to help me in any way, so I had a case from Riga, the eggs taken out, and brought all the straw home with me, and have spent the day examining it." The results of this examination were one straw with a hole in it, one curiously deformed, and some that appeared to have had at some

time some insect within, but no Hessian Fly presence; and Mr. Riley noted regarding the state of the straw, "The straw they are packed in appears to me to have been put through a bruiser to soften it and shorten, so that if there were chrysalids in it they would get crushed." Very large quantities come weekly yet, about 100 tons freightage from Galicia, Southern Russia, and Belgium."

On Nov. 29th, Mr. Riley informed me that the straw, of which he had sent some samples, was that of Rye, and that large quantities of eggs were imported from Bohemia and Silesia, as well as from Galicia: "they are still coming in large quantities, 120 tons a week." At the same date Mr. Riley favoured me with information which Mr. G. Becker, the chief importer of foreign eggs, had been good enough, on Mr. Riley's request, to furnish us with.

Mr. Becker mentioned, relatively to preparation of packing material, that there were important differences between the western and south-western districts of Russia, which do not forward through Riga, and the central, eastern and south-eastern districts, which last send their goods through Riga.

The former, that is, the western and south-western, go to Hamburg either direct through Russia, or through Galicia (Austria), and this traffic, being a very quick one, does not pay any particular attention to the straw if it only appears to be dry.

The other districts, however (the goods having to pass over enormous distances), use every possible caution to have perfectly dry straw, and for that purpose *it is dried in heated rooms in racks.*"

From the above information it may be considered that a portion of the straw accompanying the eggs is necessarily so treated that it is unlikely in the extreme that Hessian Fly infestation can be imported in it, and, further, that where the straw is, firstly, cut so high as in the natural course of things to leave the puparia, or flaxseeds, remaining behind on the stubble in the fields; 2ndly, where it is bruised to the extent to which this is done in the samples sent me, so as to make it a soft mass, and no longer firmly connected stems and sheaths; and 3rdly when, as is shewn, the packing straw, whether artificially dried or not, *must be dry*, which is a very unfavourable state for development of Hessian Fly, there does not appear to be much likelihood of transmission. But should it be necessary, it is shewn by the above observations that there is a practicable way of putting an end to all danger of infestation by extending the practice, now carried on to some extent, of drying the straw in heated chambers.

INDEX.

- Agrotis segetum*, 96
 Aldersey Grammar School, useful entomological teaching at, 112, 113; warbles destroyed by boys at, 113
Anguillulidæ, 1—9, 64—71
Aphis, Hop, 83—86
Aphis, Turnip (Preface)

 Bos, Dr. J. Ritzema, on *Anguillulidæ*, 2—5, 7, 64, 65, 67
 Buff-tip Moth, 81
 Butterflies, White Cabbage, 87—89; hand-picking to remove caterpillars of, 89; ichneumon fly of, 89

Calandra granaria, 71—75
 ,, *oryzæ*, 75; life-history of, 75, 76
 Carnations, eelworm disease of, 7
Cecidomyia destructor, 12—53; description of by Mr. R. H. Meade, 15, 16
Cephus pygmæus, 59—63
Chærocampa Elpenor, 126
Chlorops tæniopus, 54—59
 Clover, 1—9; diseased by fungus, 3, 4; *T. devastatrix*, 2, 4, 5; "sickness," 1—9; applications beneficial for, 5, 8; infectious, 7
 Cockle-gall, 65
 Corn, 9—77
 Corn Fly, Ribbon-footed, 50, 54—59; at High Legh, Cheshire, 48, 58; localities of attack of, 55—58; not a new attack, 55
 Corn Sawfly, 59—63; localities of attack, 60; method of life of, 60—63
Cœnurus cerebralis, 123
 Currant, Black, 77—81; gall-mite of, 77; dressings for, 80; means of prevention of, 79

 Damson-Hop *Aphis*, 83, 84
 Dart (or Turnip) Moth, 96
 Davidson's composition, use of, iv
 De Man, Dr. J. G., observations on *Anguillulidæ*, 1—5, 7, 66

 Eelworms in Clover, 1—9; in Oats, 64—71
 Eggs imported from Russia, 128, 129; packing straw for, how prepared, 129
 Elm, 81—83

 Frit Fly, 9—11; means of prevention of, 11

 Gad Fly, Black American, 120
 Gad Fly, Ox, 118—120
 Gall-mite of Black Currant, 77
 Gas-lime, 80

 Hessian Fly, 12—54; appearances of in England during July and August, 20—28; in Scotland during July and August, 28—33; first appearances in 1887 on Barley, 18; in captivity, 17; from chrysalids of 1887, 36; area of infested districts in 1886 and 1887, 50, 52, 53; maps of, 52, 53; life-history of, 13; maggots reared from eggs of, 35; methods of prevention of, 45—48; non-presence of "flax-seeds" in imported straw, 44, 45, and Appendix; attack not observed in extreme north of Scotland and Orkneys, 35; nor in Oats, 39; observations regarding in S.E. of Scotland, 33; parasites of, 36—39; Wheat, kinds of, little injured by, 40—43
 Hop, 83—86
 Hop *Aphis*, 83, 86; migration of, 85, 86
 Horse Warble, 117
 Hydatid of sheep's brain, 122, 123
Hypoderma bovis, 102

 "Indian dust," 75

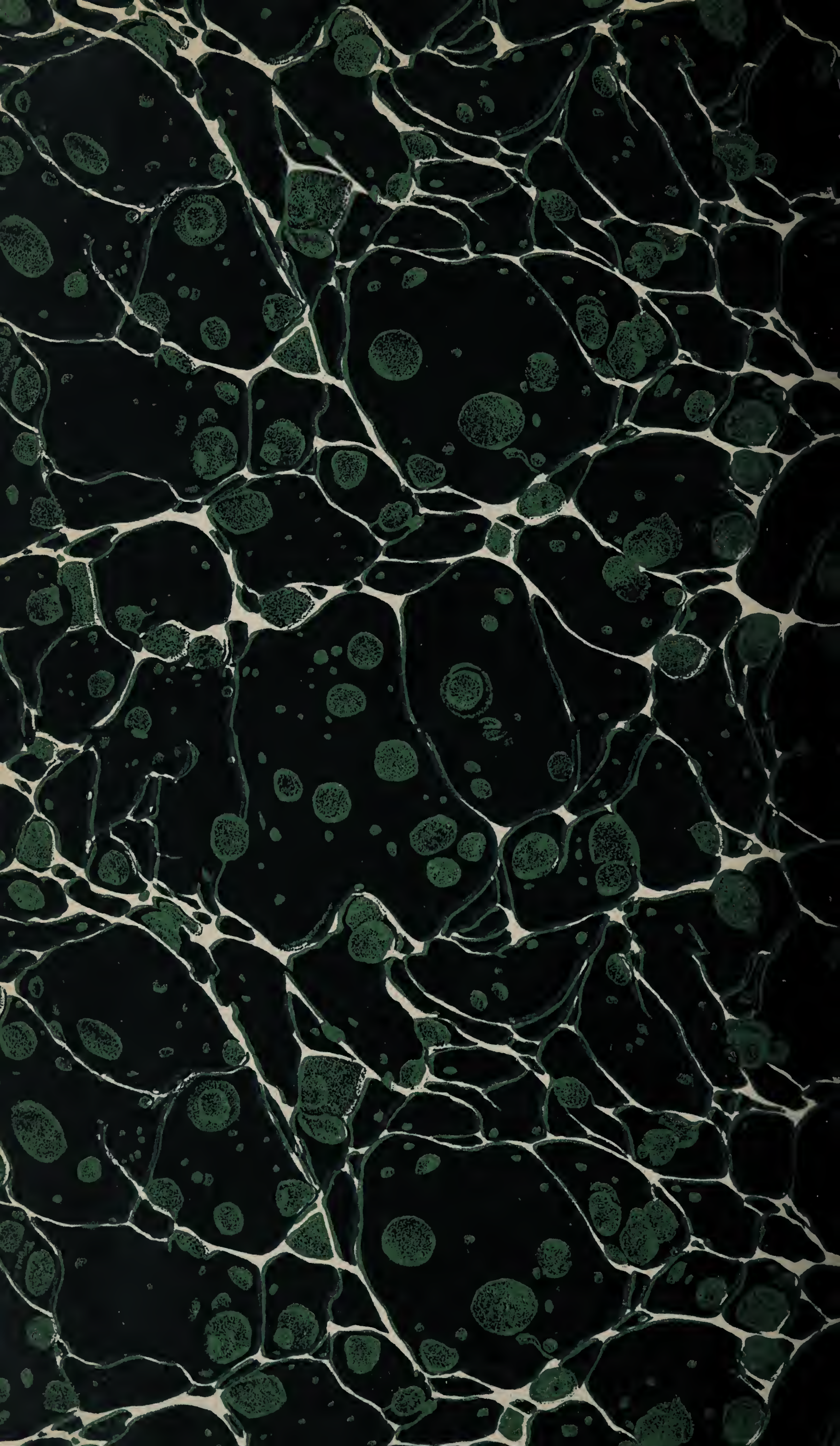
 Kale, 87, 88

 Lindeman, Dr. Ch., information given by regarding Hessian Fly parasites, 37, 38

 "Murrain worm," 126, 127; food of, 126; not injurious to cattle, 126

 Ox Gad Fly, 118—120; life-history of, 119
Æstrus (*Hypoderma*) *bovis*, 102—117
 ,, (*Cephalomyia*) *ovis*, 121—125
 Ox Warble Fly, 102—117
 Ox Warbles, assistance by societies in prevention of, 103—105; benefit from killing maggots of, 104, 109—111, 113, 114; exhibition of hides injured by, 102, 103; ignorant views regarding, 106, 107; injurious to health of cattle, 107, 108; "note" on, 115—117; summer galloping from attack of fly of prevented, 110, 111

- Oscinis frit, 9—11; ? *O. vastator*, 9—11
- Pear Sawfly, 90—92; Slugworm, 90; to destroy, 92
- Pine Sawfly, 93
 „ small, 93, 95; caterpillars of, 94; observations of, 93, 95; to destroy, 95
- Phorodon Humuli, 83—86
- Plum, migrations of Hop Aphis to and from, 85, 86
- Phytoptus ribis, 77—81
- Pieris brassicæ, 87
 „ rapæ, 87
- Pygæra bucephala, 81; on evergreen oak, 82
- Riley, Prof. C. V., observations on Hop Aphis, 85; on Hessian Fly parasites, 37—39
- Russian straw, examination of, Appendix; “flax-seeds” not found in, 44, 45, and Appendix
- Sawfly, Corn, 59—63; Pear, 90—92; Pine, Common, 93; Pine (? sp.), 93—95
- “Segging,” 64, 67
- Sheep, brain-hydatid of, 122, 123; nostril-maggot of, 121—125; description of, 122, 124; habits of, 122, 124; means of prevention of, 125
- Slugworm, Pear and Cherry, 90, 92
- Soft-soap and sulphuret of lime wash, 80
- Straw (imported) examination of, 44, 45, and Appendix
- Sulphate of potash to check eelworm disease, 69, 70
- Sulphur and lime, 80
- Sulphuret of lime and soft-soap wash, 80
- Tabanus atratus, 120
 „ bovinus, 118
- Tenthredo cerasi, 90—92
- Tulip-root in Oats, 64—71; disease checked by mixture of sulphate of potash; not checked by nitrate of soda, 69
- Tylenchus devastatrix, 1—9, 64—71; infests Carnations, 7; Clover, 1—9; Oats, 61—71; Rye, 64; Wheat, 66; not found to infest Barley, 71; plants liable to be infested by, 70.
- Tylenchus tritici, 65
- Turnip, 96—101; grub, 96—101; found in winter, 99, 100; hand-picking to destroy, 98, 99, 100
- Warble, Horse, 117; Ox, 102—117
- Weevils, Granary, 71—77; means of prevention of, 74, 75; to clear corn from, 73
- White Cabbage butterflies, 87—89
- Winter moth, to prevent attack of, iv



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